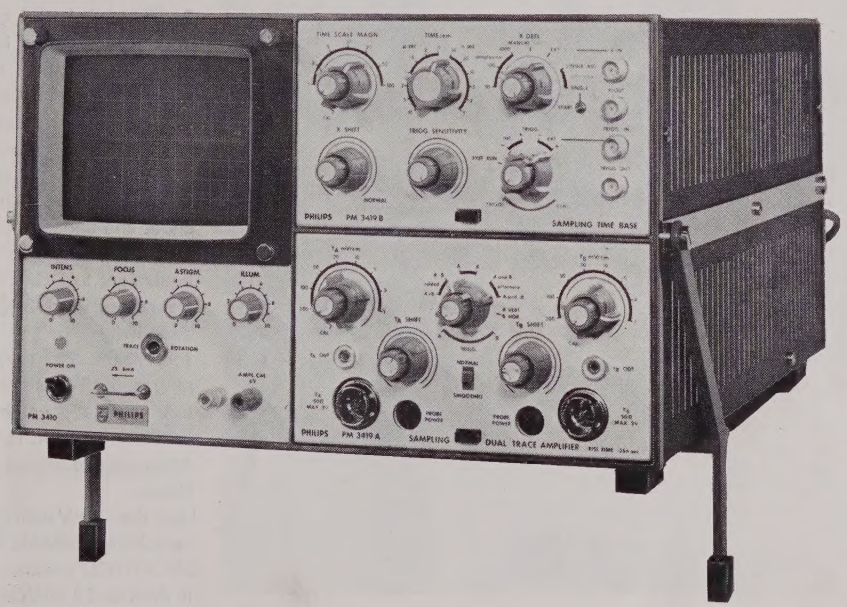
1000 MHz SAMPLING OSCILLOSCOPE, TYPE PM 3410 WITH HIGH-SENSITIVITY—15 MHz MEASURING FACILITIES



1 mV/cm sensitivity up to 1000 MHz, 500 μV/cm below 15 MHz

Signal delay line incorporated in sampling and real-time amplifiers

8 x 10 cm rectangular cathode ray tube, with full area available for display

Easy operation in both sampling and real-time forms

Particularly easy and stable triggering through to 1000 MHz

Small size and clean, modern appearance in both bench and rack-mounting forms

Sampling oscilloscope

Dual trace sampling — PM 3410 and PM 3419

Rise time 0.35 ns

Bandwidth corresponding to 1000 MHz

Sensitivity 1 mV/cm

Real-time oscilloscope

Real time — PM 3410 and PM 3417/18

Bandwidth DC - 15 MHz

Sensitivity 500 μV/cm

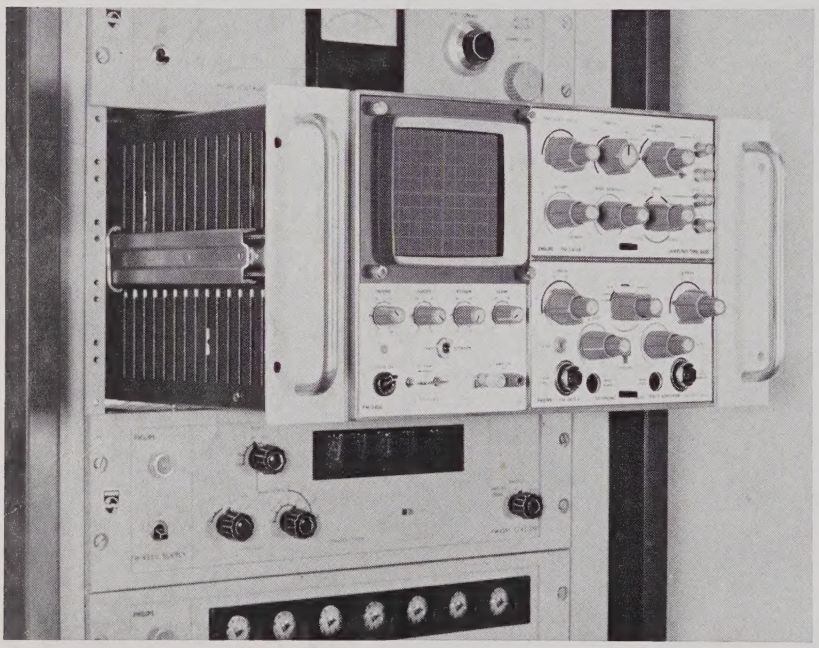
Drift 2 mm/week

DESCRIPTION

Together the "real-time" and sampling forms of the PM 3410 oscilloscope system offer complete coverage for measurements of small signals from DC up to 1000 MHz; though in either form, by itself, the user has a complete instrument.

The oscilloscope is based on the main frame, PM 3410, which contains the cathode ray tube and its associated controls in the left-hand side, and apertures for the real-time or sampling units in the right-hand side. The main frame also contains the power supply, vertical and horizontal output amplifiers, and the calibration facilities. The wide, low format of the main frame makes it easy to adapt the instrument to 19″ rack mounting, while the use of side plates with runners for this purpose allows the instrument to be small when used on the bench.

Full sampling facilities are afforded when the sampling plug-ins PM 3419A and B are used, while for those who need them the precision real-time plug-ins PM 3417 and PM 3418 offer compatible sensitivity from DC to 15 MHz.



The sampling oscilloscope PM 3410 can easily be built into a 19″ rack by means of the sliding rack mount, type PM 9349.

TECHNICAL DATA

MAIN FRAME PM 3410

Cathode ray tube
Type: Single gun, rectangular
Acceleration voltage: 4 kV
Display area: 10 x 8 cm
Type number: D14 - 10 GH (GH = green, short persistence)
Phosphors available on request:

BE - Blue	Very short
GP - Blue/green	Medium
GM - Yellow	Long

Z-modulation
Sensitivity: 30 V_{p-p}
Frequency range: 40 Hz ... 1 MHz
Input impedance: 10 kΩ shunted by 25 pF

Calibration voltage
Amplitude: 6 V_{p-p}
Tolerance: 1 %
Frequency: 1000 Hz
Waveform: square wave

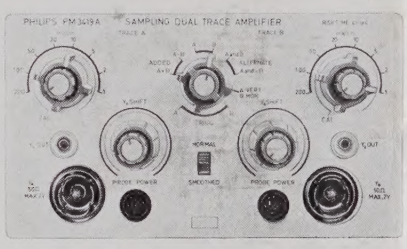
Calibration current
Amplitude: 6 mA
Tolerance: 1 %
Frequency: 1000 Hz
Waveform: square wave

Mains supply
Voltages: 110, 125, 145, 200, 220, 245
Permissible variations: 10 %
Max. power consumption: 140 VA

Dimensions
Height: 22 cm (8½″)
Width: 35 cm (13¾″)
Length: 52 cm (20½″)

Weight 20 kg (44 lb)

DUAL-TRACE SAMPLING AMPLIFIER PM 3419A



Mode of operation
1. Channel A only
2. Channel B only
3. Channel A and channel B
4. Channel A and inverted channel B
5. Channel A plus channel B
6. Channel A minus channel B
7. Channel A vertical and channel B horizontal

Rise time
0.35 ns or less, with less than 3 % overshoot and undershoot

Frequency response
Equivalent to DC ... 1000 MHz

Overshoot $< \pm 3\,\%$

Sensitivity
1 mV/cm ... 200 mV/cm, 8 calibrated ranges, 1 - 2 - 5 sequence. A variable control permits uncalibrated, continuous adjustment between ranges

Attenuator tolerance $\pm 3\,\%$

Noise
Less than 2 mV with NORMAL-SMOOTHED switch in NORMAL, and less than 1 mV in SMOOTHED position. Automatic smoothing in the 1 and 2 mV/cm positions
(Noise measured as 3 x RMS, or observed signal excluding 10 % of random dots)

Isolation between channels
More than 40 dB up to 1000 MHz

Input impedance
50 Ω, input connectors type GR 874 (locking type)

Signal delay
35 ns for each channel, visible delay 10 ns

Dynamic range
± 1.6 V (f.s.d.)

Input voltage
Max. ± 5 V DC

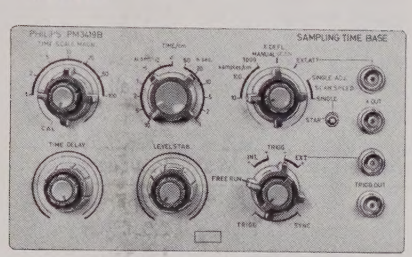
Internal trigger
Triggering can be selected from either channel A or B

Recorder output
Channel A and channel B; output amplitude 0.5 V/cm through 1 kΩ

Dimensions
Height 10.5 cm (4″)
Width 19 cm (7½″)
Depth 32 cm (12½″)

Weight 5 kg (11 lb)

SAMPLING TIME BASE PM 3419B



Sweep speeds
1 ns/cm ... 10 µs/cm (± 3 %), 13 calibrated ranges, 1 - 2 - 5 sequence

Magnification
x 1 ... x 100 (± 5 %), 7 calibrated ranges, magnification around middle of the screen
Variable control magnifies from the beginning of the screen.

Shift
Coarse and fine controls provide horizontal shift of one unmagnified screen width

Deflection
Repetitive with 10, 100 or 1000 samples/cm
Manual scan
External scan by external voltage
Single adjustment with repetitive internal slow ramp with sweep time adjustable from 1 to 60 seconds per sweep (also single shot facilities)

Recorder output
0.5 V/cm through 1 kΩ (BNC-connector)

TRIGGER FUNCTIONS

Trigger modes
Internal and external, positive or negative, free run

Amplitude
5 mV_{p-p} ... 250 mV_{p-p} for external trigger signal; 40 mV_{p-p} for internal trigger

Pulse width
More than 1 ns at minimum amplitude

Frequency range
Up to 1000 MHz

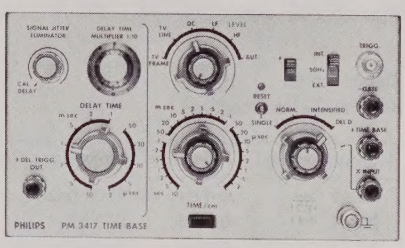
Jitter
Less than 30 ps or 2 mm with sweep magnified 100 times

Output
Pulse amplitude: approx. +2 V into 50 Ω
Rise time: less than 4 ns
Width: approx. 35 ns

Dimensions
Height 10.5 cm (4")
Width 19 cm (7½")
Depth 32 cm (12½")

Weight 1.6 kg (3½ lb)

DOUBLE TIME BASE PM 3417



The double time base PM 3417 incorporates two sawtooth generators, one trigger circuit and the horizontal amplifier.

Display modes
Time base A only
Time base A single shot
Time base B intensified by time base A
Time base A delayed by time base B
Horizontal deflection by external signal

Sweep speed (time base A)
0.1 µs/cm ... 10 s/cm, calibrated, 1 - 2 - 5 sequence; uncalibrated continuous adjustment between steps

Tolerance 3 %

Sweep speed (time base B)
2 µs/cm ... 10 ms/cm, calibrated, 1 - 2 - 5 sequence

Tolerance 3 %

Expansion x 5 (± 5 %)

Delay time adjustment
By 10-turn potentiometer, maximum delay 100 ms

Delay time jitter
1 : 10^4 of full scale time

Triggering mode
Automatic, 50 Hz ... 10 MHz (automatic setting of level and stability control)
DC-coupled
LF frequencies over 1.5 Hz (high pass filter rise time 100 ms)
HF frequencies over 2000 Hz (high pass filter rise time 0.1 ms)
TV frame } sync separator for TV frame
TV line } and line pulses

Source
Internal, external or mains

Slope
Positive or negative

Sensitivity
Internal: 5 mm up to 1 MHz, 1 cm up to 10 MHz, 5 mm_{p-p} video for TV
External: 500 mV up to 10 MHz

Input impedance
1 MΩ shunted by 25 pF

Trigger facilities
The trigger data are valid for time base A in the first two display modes, and for time base B in the third and fourth. In these two latter modes time base A is triggered by the delayed trigger pulse in the mode "start A", or by the next signal variation after the delayed trigger pulse in the mode "sets A ready" (jitter-free display)

HORIZONTAL AMPLIFIER

Bandwidth DC ... 5 MHz

Sensitivity 1 V/cm, expanded 200 mV/cm

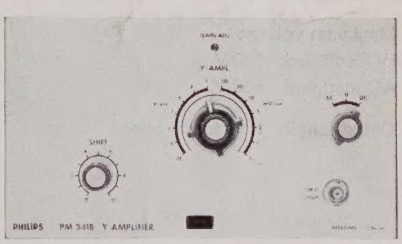
Input impedance 1 MΩ shunted by 15 pF

Time base outputs
Time base A sawtooth: 10 V_{p-p} positive going
Time base A gate: 12 V_{p-p} negative
Delayed trigger pulse: 5 V_{p-p} positive

Dimensions
Height 10.5 cm (4")
Width 19 cm (7½")
Depth 32 cm (12½")

Weight 2.5 kg (5 lb)

HIGH SENSITIVITY, WIDE-BAND AMPLIFIER PM 3418



This amplifier has no visible short-term drift, resulting in accurate measurements of signals riding on a small DC level.
Switching to higher deflection sensitivities does not cause jumping of the displayed signal. Drift-free means in fact a drift of less than 2 mm/week, meaning that yesterday's display can be compared directly with today's without noticing any drift.
The sensitivity of 500 µV/cm is effective for the complete frequency range, i.e. from DC to 15 MHz.

Bandwidth DC ... 15 MHz

Sensitivity 500 µV/cm

Drift
Short-term: not visible
Long-term: 2 mm/week

Attenuator
Calibrated 500 μV/cm ... 10 V/cm (1 - 2 - 5 sequence), continuous uncalibrated gain between steps

Tolerance 3 %

Input impedance
1 MΩ shunted by 30 pF

Maximum input voltage
400 V (DC + AC peak), AC or DC coupled

Maximum deflection
24 cm for frequencies up to 5 MHz. Complete picture can be made visible by means of shift control

Signal delay 200 ns

Visible delay 40 ns

Dimensions
Height 10.5 cm (4")
Width 19 cm (7½")
Depth 32 cm (12½")

Weight 2.5 kg (5½ lb)

Power requirements
6.3 V - 180 mA and 70 V - 12 mA
(front panel connector)

Cable length
140 cm, GR connector

Coupling-capacitor head
0.002 μF, 400 V DC
Lower 3 dB point 8 Hz

Packing
Wooden box with space for all parts and the probe

Attenuator head	Rise time	Equivalent bandwidth	Max. input volt.*	Input capacitance
10 : 1	0.4 ns	850 MHz	± 1.5 V	3.6 pF
20 : 1	0.4 ns	850 MHz	± 3.0 V	2.6 pF
50 : 1	0.4 ns	850 MHz	± 7.5 V	1.8 pF
100 : 1	0.4 ns	850 MHz	± 15 V	1.5 pF
200 : 1	0.4 ns	850 MHz	± 30 V	1.4 pF
500 : 1	0.4 ns	850 MHz	± 75 V **	1.3 pF
1000 : 1	0.4 ns	850 MHz	± 150 V **	1.3 pF

* Limited by linearity of cathode follower
** Must be derated when used for continuous wave measurements over 500 MHz

Attenuator head	Max. input voltage for HF continuous wave			
	500 MHz	750 MHz	1000 MHz	1250 MHz
500 : 1	150 V	150 V	150 V	125 V
1000 : 1	300 V	200 V	150 V	125 V

DC input resistance
10 MΩ for all attenuator heads

PASSIVE PROBE PM 9326A/10

Attenuation 10 : 1

Tolerance 3 %

Input impedance 10 MΩ shunted by 8 pF

Maximum voltage
DC coupled 1000 V_{p-p}
AC coupled 500 V_{p-p}

Cable length 1 metre

CATHODE-FOLLOWER PROBE

The PM 9340 cathode-follower probe is intended for use with the PM 3419A and B in conjunction with one of the attenuator heads from the set PM 9341. The attenuator heads can be adjusted to equalize the AC and DC attenuation.

Output
Max. ± 150 mV into 50 Ω

Signal delay
Approx. 10 ns

PASSIVE PROBES PM 9342 (10 : 1) AND PM 9343 (100 : 1)

These are low-capacitance miniature passive probes affording higher input impedance to the 50 Ω sampling amplifier

PROBE	Attenuation ratio	Input resistance ± 1.5 %	Input capacitance to 1000 MHz	Probe rise time	Pass-band (3 dB down)	Cable length	Max. voltage	Max. voltage for 1 GHz Continuous wave
PM 9342	10 : 1	500 Ω	0.7 pF	100 ps	3.5 GHz	50 cm	16 V DC 40 V_{p-p}	60 V_{p-p}
PM 9343	100 : 1	5 kΩ	0.6 pF	200 ps	1.7 GHz	50 cm	50 V DC 140 V_{p-p}	25 V_{p-p}

Maximum ringing and overshoot for both probes is 2 % when using the "T"-piece and 5 % when using the earth chips (measured with a 0.5 ns risetime pulse). The cable length of either probe can be extended using high quality 50 Ω coax.

Packing
Each probe is packed in a wooden box with space available for the "T"-piece.

T-PIECE PM 9344

The "T"-piece allows the user to pick-off a signal from a closed 50 Ω system while causing the minimum possible disturbance. It can only be used in conjunction with one of the passive probes PM 9342 and PM 9343.

Frequency range DC ... 2 GHz

Characteristic impedance 50 Ω

Reflection coefficient
Without probe < 5 %
PM 9342 (10 : 1) < 15 %
PM 9343 (100 : 1) < 7 %

Connectors 874 PL, GR type

Dimensions
Length 17 cm
Diameter max. 8 cm

Printed in the Netherlands - Edition 1A
Data subject to alteration without notice

WIDE BAND HIGH SENSITIVITY OSCILLOSCOPE

PM 3410 - PM 3417 - PM 3418 - PM 3419A - PM 3419B

With this oscilloscope system, measurements can be carried out in the frequency range of DC-1 GHz, with a sensitivity of 1mV/cm.

The first part of this frequency range, from DC-15 MHz, is covered by the vertical amplifier PM 3418 in combination with the time base unit with trigger delay PM 3417.

The second part of the frequency range is covered by the double beam sampling amplifier PM 3419A in combination with sampling time base unit PM 3419B. The basic instrument of this system which, amongst others, includes the cathode ray tube and the supply section, is the PM 3410 or the PM 3410R; the latter being intended for incorporation in a 19″ rack.

IMPORTANT

In correspondence concerning these apparatus, please quote the type number and the serial number as given on the type plates at the rear of the apparatus.

ERRATA PM 3410

A. Circuit diagram, supply section, Fig. 40

1. -50 V unit

   R102 is connected between the base of TS101 and the 0 V line.

   R102 = 22 K, R112 = 8K2, R113 = 3K3.

2. +50 V unit

   R116 is connected between the base of TS106 and the +50 V line.

   R116 = 22 K, R126 = 22 K, R127 = 3K3.

3. -15 V unit

   R129 is connected between the base of TS111 and the 0 V line.

   R129 = 6K8, R139 = 15 K, R141 = 3K3.

4. +15 V unit

   R143 is connected between the base of TS116 and the +15 V line.

   R143 = 6K8, R153 = 22 K, R154 = 3K3.

5. +100 V unit

   R155 is connected between the base of TS121 and the +100 V line.

   R155 = 56 K (code number altered into 902/P56K).

   R164 = 27 K.

   R166 = 22 K (code number altered into 902/P22K).

6. +6.3 V unit

   R169 is connected between the base of TS126 and the +6.3 V line.

   R182 is connected between the base of TS131 and the -50 V.

   R183 has been cancelled.

   R169 = 3K3, R179 = 22 K, R181 = 1K2.

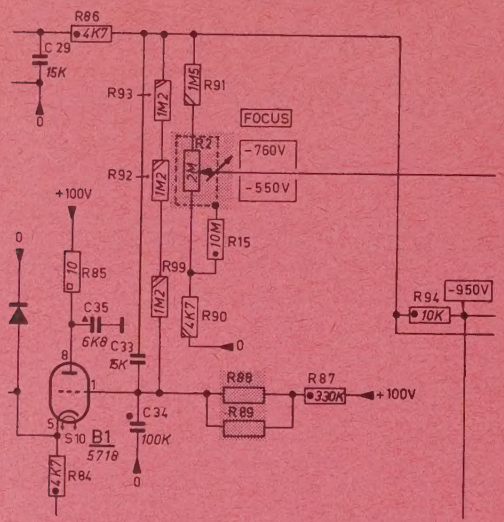
   R182 = 10 K (code number altered into 902/P10K).

B. Units B, C, D, E, G and H, figures 27, 28, 29, 30, 32 and 33

The print plates have been altered in accordance with the alterations described in point A.

C. Circuit diagram PM 3410, Fig. 41

1. Zenerdiode GR26 (BZY65) has been added parallel to C27 (cathode connected to zero). The diode is mounted on unit N.
2. Circuit and resistor values have been altered in keeping with the figure below.



D. Simplified diagram of the high voltage unit, Fig. 9

Altered in keeping with the alterations in the circuit diagram, according to point C2.

E. Units A, M, N and P, Figs. 26 and 36

The print plates have been altered in keeping with the alterations in the circuit diagram, according to points C1 and C2.

1. Unit A

   R90 (transferred from unit M) added between junction R2-R15 and the 0 V.
   Connection wire, originally connected to R90, removed from the unit.

2. Unit M

   R90 altered into R99.
   R87 is connected between junction R89-R88 and the +100 V.
   Connection wire, originally connected to R2-R15, removed from the unit.
   R92 is connected to the relevant soldering point. The other side of R92 is connected to R93 on unit P.

3. Unit N

   GR26 has been fitted between the fourth and the sixth connection point from the top.

4. Unit P

   R92 has been loosened at the top and connected to unit M (see point E2).

PEM 3055

PHILIPS

MANUAL

BASIC OSCILLOSCOPE PM 3410

66 405 39.1-10 15/666/0

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GENERAL INFORMATION

Introduction

The PM 3410 forms the basic part of the wide band oscilloscope and contains, amongst others, the supply section, the cathode ray tube with square screen, the high voltage unit, the horizontal and vertical output amplifiers and a calibration section. The PM 3410R is identical to the PM 3410, but is adapted for mounting into a 19″ rack.

Technical data

Properties expressed in numerical values with tolerances stated are guaranteed by the factory. Numerical values without tolerances stated represent the properties of an average instrument and merely serve as a guide.

The following data apply in case of nominal mains voltage and an ambient temperature of max. 35 °C, unless otherwise stated.

A. CATHODE RAY TUBE CIRCUIT

Tube	D14–10 GH, with square flat screen. Useful screen area: 100 × 80 mm. Acceleration voltage: 4 kV
Unblanking	D.C. coupled
Trace rotation	Electrically, by means of a screw-driver adjustment on the front plate
Brightness modulation	Required voltage: 30 V_p Bandwidth: 40 Hz–1 MHz Input impedance: 10 kΩ//25 pF
Measuring graticule	100 × 80 mm, with X and Y indication on the axes. Intermediate divisions of 2 mm. The graticule illumination is continuously adjustable.

B. CALIBRATION SECTION

Voltage	Square-wave voltage: 6 V_{p-p}, ± 1% Frequency: 1,000 Hz
Current	Current bracket through which a square-wave current flows of 6 mA_{p-p}, ± 3% Frequency: 1,000 Hz

C. SUPPLY

Mains voltage	The apparatus is suited for connection to mains voltages of 110, 125, 145, 200, 220 and 245 V. Maximum permissible mains voltage variation ± 10%. Frequency: 50 or 60 Hz
Power consumption	Maximum 77 VA (PM 3410 only)

D. MECHANICAL DATA

Dimensions	PM 3410	Length : 565 mm Width : 350 mm Height : 220 mm
	PM 3410 R	Depth : 550 mm (measured from the text plate) Width : 19″ Height : 5 units
Weight		20 kg

Optional accessories

III

1.* Test unit for checking and adjusting the PM 3410.
Code number: 4822 395 30015.
2.* Extension print plates for carrying out measurements on the supply panels while the instrument is in operation (see Fig. 1).
Code number: 4822 159 00561 (for units B,C,E,F, G and H)
4822 159 00562 (for unit D)
3. Adaptation set for rack-mounting of the PM 3410
Type number: PM 9349
4. Oscilloscope trolley
Type number: PM 9319
5. Adaptation flange for photographic equipment PM 9300.
Type number: PM 9315

**These items should be ordered from the Central Service Department.*

Oscilloscope trolley PM 9319

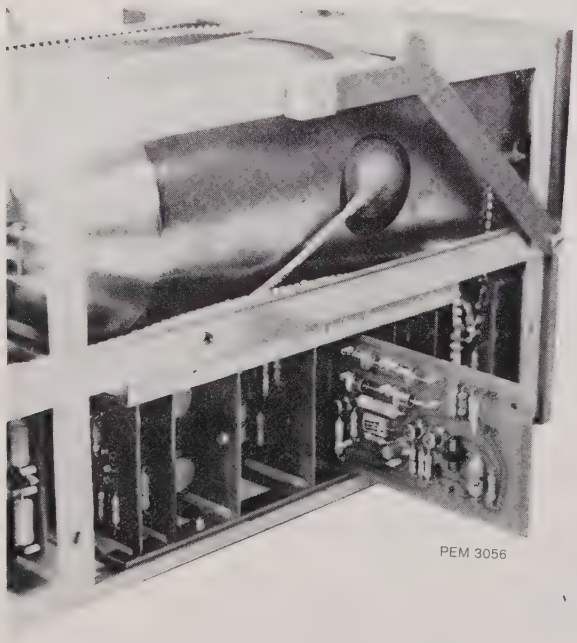


Fig. 1. Use of extension print plates

Block diagram description IV

The supply section delivers the required voltages and currents for the basic instrument as well as for all plug-in units.
Furthermore, the basic instrument also contains the vertical and the horizontal output amplifier and the E.H.T. supply for the cathode ray tube with, amongst others, the focus and intensity controls.
The unblanking signal ensures the unblanking of the cathode ray tube during the scan of the time base.

The cathode ray tube circuit also contains adjusting facilities for geometry (barrel and cushion distortion), centring of the electron beam and astigmatism.
Brightness modulation can be effected via BU4 ("Z-MOD").

Finally, the calibration section delivers a calibrated voltage to BU1 ("AMPL. CAL") and a calibrated current through the current bracket.

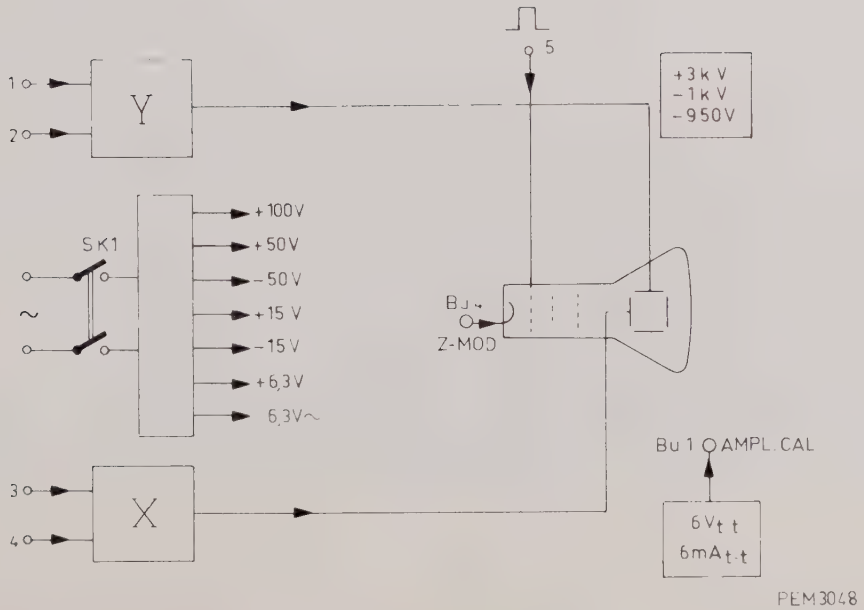


Fig. 2. Block diagram

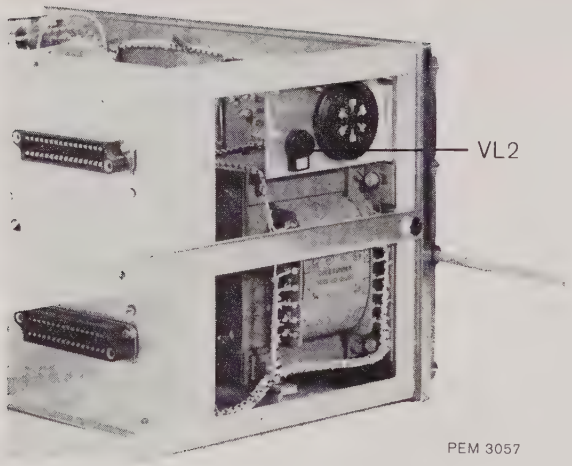


Fig. 3. Voltage adapter and fuse

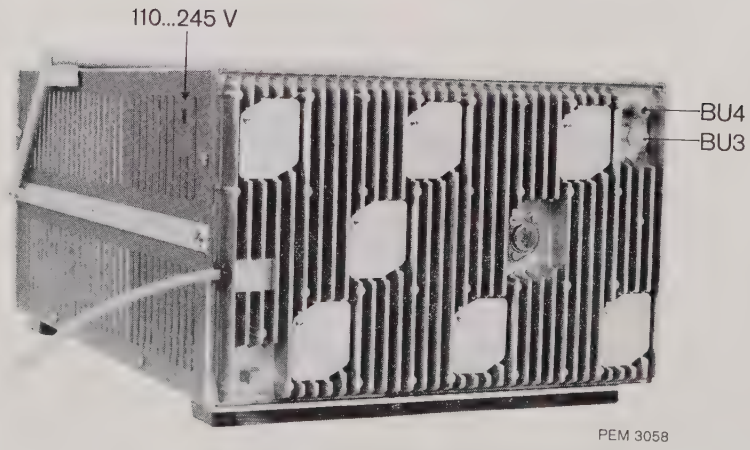


Fig. 4. Rear view

DIRECTIONS FOR USE

Installation

A. POSITIONING THE INSTRUMENT

Always place the instrument so that the air circulation along the bottom and the rear is not impeded so that proper cooling is ensured. The ambient temperature may not exceed 45 °C.

B. ADJUSTING TO THE LOCAL MAINS VOLTAGE

The apparatus can be adjusted to mains voltages of 110, 125, 145, 200, 220 and 245 V by means of a voltage adapter.
The set voltage value can be read through the aperture in the right side panel (Fig. 4).
Adjustment to another mains voltage is effected as follows:
- Remove the top plate (see VIII A).
- Pull out the voltage adapter.
- Turn the adapter until the desired voltage is topmost and press it in again.
- Refit the top plate.

Note: When used on a mains voltage of 110, 125 or 145 V, fuse VL2 (see Fig. 3) having a value of 1 A should be replaced by a fuse having a value of 2 A.

C. EARTHING

The apparatus should be earthed in accordance with the local safety regulations. This can be effected as follows:

a. Via the mains flex; the apparatus is provided with a 3-core mains flex.

b. Via one of the earthing sockets BU2 or BU3 (Fig. 5 and Fig. 4 respectively).

AVOID DOUBLE EARTHING!

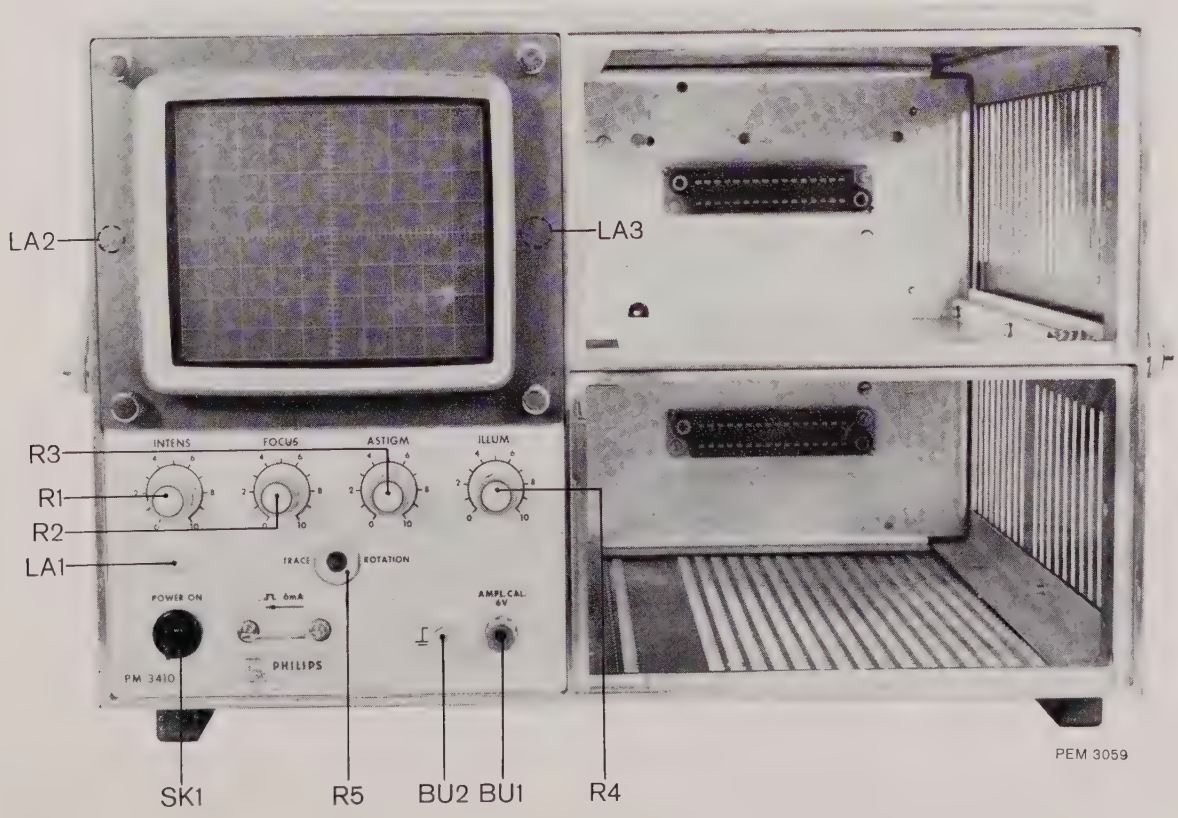


Fig. 5. Front view

D. CONNECTION TO THE MAINS AND SWITCHING ON

- Check that the voltage adapter is in the correct position.
- Earth the apparatus.
- Fit the desired plug-in units.
- Connect the apparatus to the mains.
- Set mains switch SK1 to position "POWER ON".
- Pilot lamp LA1 should light up.

Remarks:

- If no Z-modulation is applied it is recommended to interconnect sockets BU4 and BU3 by means of the short-circuiting strip.
- It is recommended to switch off the apparatus when the plug-in units are replaced.

Operation

VI

Below, a survey is given of the knobs and sockets of the basic instrument (see Fig. 5).

For displaying the signals, refer to the descriptions of the relevant plug-in units.

INTENS (R1)	Intensity of the electron beam
FOCUS (R2)	Focusing of the electron beam
ASTIGM. (R3)	Controls the shape of the spot
ILLUM (R4)	Graticule illumination
TRACE ROT. (R5)	Rotation of the trace for obtaining a horizontal position
POWER ON (SK1, LA1)	Mains switch with pilot lamp
AMPL. CAL. (BU1)	Calibration voltage socket
CURRENT BRACKET	Calibration current bracket
⏚ (BU2)	Earthing socket
Z-MOD (BU4)	Input socket for beam modulation (see Fig. 4)
⏚ (BU3)	Earthing socket (see Fig. 4)

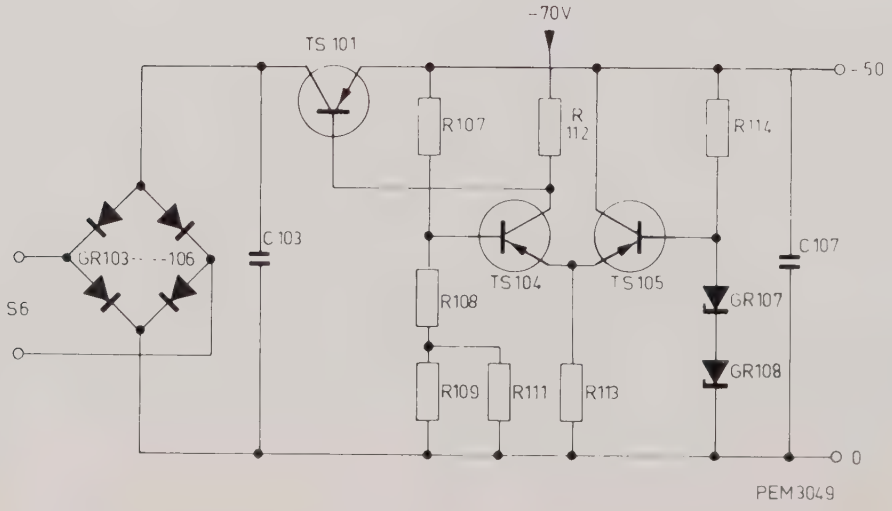


Fig. 6. Simplified diagram, —50 V unit

SERVICE NOTES

Circuit diagram description VII

The basic oscilloscope consists of the following separate sections.

A. The supply section, delivering d.c. voltages of +50, —50, +15, —15, +100 and +6.3 V.

B. A d.c. amplifier serving as output amplifier for the vertical channel.

C. A d.c. amplifier serving as output amplifier for the horizontal channel.

D. The high voltage supply for the cathode ray tube with controls for focus and intensity.

E. The cathode ray tube circuit with controls for astigmatism, beam centring and geometry. This circuit also includes an input socket for Z-modulation.

F. A calibration section delivering a calibration voltage as well as a calibration current.

The above sections will be described in succession.

A. SUPPLY SECTION

The supply section consists of various units, all based on the same principle.
Here, the unit delivering a d.c. voltage of —50 V will be described, after which the main deviations of the other supply units with respect to this unit will be given. Fig. 6 shows a simplified diagram.

The voltage, rectified by a Graetz circuit and smoothed by C103, is applied to the output terminals via TS101. The output voltage is stabilised by comparing the output voltage, via differential amplifier TS104–TS105, with a reference voltage and controlling the current through transistor TS101 with the output voltage of the differential amplifier.
The output voltage of the supply unit, determined by the reference voltage and voltage divider R107–R108-R109// R111, can be accurately adjusted with choice resistors R109 (coarse) and R111 (fine).
So as to make sure that the differential amplifier delivers sufficient amplification, collector resistor R112 is connected to a voltage of —70 V.
This voltage is obtained by adding the output voltage of an additional supply section, consisting of rectifier diode GR101 and Zener diode GR102, to the —50 V voltage (see circuit diagram, Fig. 41).
The circuit diagram of this unit also shows that the control voltage, coming from the collector of TS104, is applied to the base of TS101 via TS102.
TS102 provides an additional current amplification. C104 serves to counteract oscillation phenomena while C106 applies the 100 Hz ripple, produced on account of the full wave rectification, directly to the base of TS104, so that this ripple is reduced considerably by this negative feedback.
The supply unit is protected against overloading (e.g. switching on surges) and short circuiting. The principle of the protection circuit will be explained with the aid of Fig. 7.

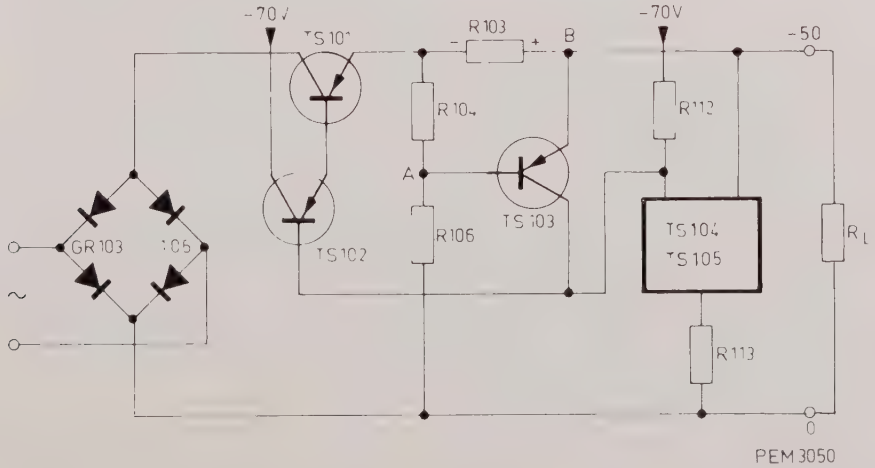


Fig. 7. Overload protection circuit

Under normal operating conditions, i.e. at nominal value of load resistor R_L, point A is positive with respect to B and transistor TS103 is blocked. The current through series transistor TS101 is therefore determined completely by the output voltage of differential amplifier TS104–TS105.

If the load increases, the voltage drop across R103 wil increase.

The voltage at point A becomes more negative, while the voltage on point B remains practically constant. At a certain value of load resistor R_L, the voltage on point A will become so much more negative that TS103 becomes conductive.

The current through TS103 is delivered by the auxiliary voltage as is the case with the base current of TS102.

If R_L continues to decrease, the current through TS103 plus the base current of TS102, at a certain moment, will equal the maximum current that can be delivered by the auxiliary voltage.

In case of a further increase of the overload, the current through TS103 will increase at the cost of the base current of TS102, with the result that also the current through series regulator TS101 decreases.

If a full short circuiting occurs, TS103 will be bottomed and consume a current which is practically equal to the maximum current that can be delivered by the auxiliary voltage. Due to this, the base current of TS102 will be practically zero and series regulator TS101 will be blocked. The voltage across TS101 will then be approximately 50 V.

To prevent TS102 from being subjected to such a voltage, the collector of TS102 is not connected to the collector of TS101 but to the additional voltage of —20 V. In case of a short circuit, the voltage across TS102 can now not exceed 20 V.

The reference voltage, obtained by voltage divider R114–GR107–GR108, is stabilised against temperature variations because diodes having opposite temperature coefficients have been selected for GR107 and GR108. Also the collector voltage of TS104 (this is the control voltage for the unit) is practically independent from temperature variations due to the application of a "long tailed pair" circuit consisting of silicon transistors TS104–TS105. The leakage currents, occurring in both transistors due to temperature variations, are strongly fed back negatively by the common emitter resistor R113. To improve the temperature stabilisation TS104 and TS105 have been mounted close together on the printed wiring board so that a temperature variation will always occur in both transistors at the same time and to the same extent.

Series transistor TS101 is not mounted on the print plate but on the rear of the instrument, so that proper cooling is ensured.

The built-up of the circuit is such that not the voltage on the output terminals of the supply unit is stabilised but the voltage at the point where the supply is required (see Fig. 8).

A voltage drop across resistors Rp, consisting of wiring resistances and contact resistances, is eliminated

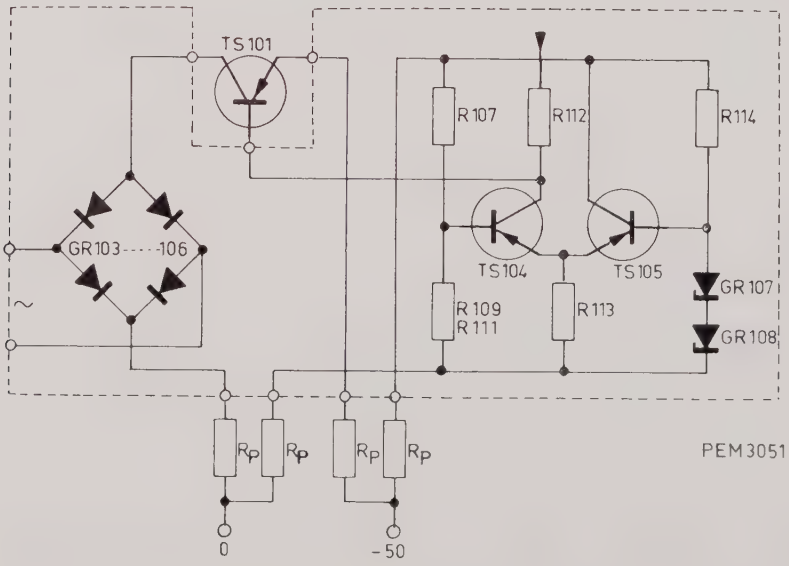


Fig. 8. Simplified diagram, —50 V unit

and interference voltages, which may arise in Rp, are stabilised.
The most important deviations of the other supply units with respect to the —50 V unit described above, are the following:

+100 V unit

To obtain the reference voltage, Zener diode GR131 and neon tube B101 are used in this unit. The ignition of B101 is effected due to its cathode being connected to the supply voltage of —50 V via GR131 and R168. The noise of B101 is short-circuited by C124.

+6.3 V unit

This unit contains an additional emitter follower TS128 so that proper regulation of the large load current is effected.

B. VERTICAL OUTPUT AMPLIFIER

The output amplifier for vertical deflection is a d.c. coupled push/pull amplifier consisting of cascode stage TS10–TS9 and TS11–TS12.
Resistors R37 and R39 serve to set the desired dissipation of TS10 and TS11 respectively. For high frequencies, these resistors are decoupled by means of capacitors C8 and C11 respectively.
The bases of TS9 and TS12 are connected to a constant d.c. voltage which is stabilised by Zener diodes GR1, GR2 and GR3.
The d.c. level of the output of the amplifier is adjusted with choice resistor R48. The amplification is adjusted with R36.
By means of coils L1 and L2, the rise time of the amplifier is improved.
To protect transistors TS10 and TS11 against an excessive collector voltage in case no d.c. voltage is applied to the input of the amplifier, (no plug-in unit in the vertical channel), the bases of both transistors are connected to the —15 V supply voltage via resistors R33 and R34.

C. HORIZONTAL OUTPUT AMPLIFIER

The output amplifier for the horizontal deflection is a d.c. coupled push/pull amplifier consisting of amplifier stage TS1–TS2, cascode stage TS4–TS3, TS5–TS6 and emitter followers TS7 and TS8.
The amplification of this amplifier can be adjusted with potentiometer R9 while the rise time of the amplifier can be improved with the aid of trimmer C2. With the aid of choice resistor R17, the d.c. level of the output of the amplifier can be adjusted.
Emitter followers TS7 and TS8 reduce the capacitive load on the cascode stage.

D. E.H.T.

The E.H.T. for the cathode ray tube is generated by an L.C. oscillator consisting of transistor TS15 and circuit S3-Cp (see simplified diagram, Fig. 9).
By means of S2, current feed-back is obtained in the emitter circuit of TS15.
The oscillator frequency is approximately 30 kHz. The following d.c. voltages are obtained on the secondary side of transformer T2 after rectifying and smoothing:

a. —950 V, which is used as cathode voltage for the cathode ray tube.
b. +3,000 V, which serves for the post-acceleration.
c. Approximately 1,000 V, which serves as voltage for the Wehnelt cylinder of the cathode ray tube.

a. Cathode voltage

Because the deflection sensitivity is proportional to the acceleration voltage, it is very important to keep this voltage constant. This is effected by stabilising the cathode voltage of the C.R.T. For this, the voltage is fed back to the oscillator via circuit R93, R92, R99, R88, R89, cathode follower B1 and amplifier stage TS16. Cathode follower B1 forms a transition between the high ohmic circuit R93, R92, R99 and the low input resistance of TS16. The —950 V can be adjusted by means of choice resistors R88 and R89 (coarse and fine respectively).
C34 short circuits the ripple of 30 kHz on the grid of B1.
Part of the cathode voltage is applied to the focusing anode (g4) by means of potentiometer R2.

b. Post-acceleration voltage

The post-acceleration anode is supplied with the voltage of 3,000 V, which is rectified by GR13...20 and smoothed by R78–C32.
Because the cathode voltage is —1,000 V, the total acceleration voltage is 4 kV.

c. Intensity control

The voltage on the first grid (Wehnelt cylinder) of the cathode ray tube is determined by the position of potentiometer R1. This voltage is always so that the electron passage to the screen is obstructed.
During the scan of the sawtooth, an unblanking pulse is applied to the emitter follower TS17 via the unblanking amplifier.
From TS17, this pulse is applied (d.c. coupled) to the Wehnelt cylinder of the cathode ray tube, via the floating 1,000 V power supply (see Fig. 10).
The d.c. level of the Wehnelt cylinder consequently rises and the cathode ray tube is unblanked.
The high frequencies of the unblanking pulse are transmitted by C36. The maximum cathode current of the C.R.T. is adjusted with choice resistor R69.

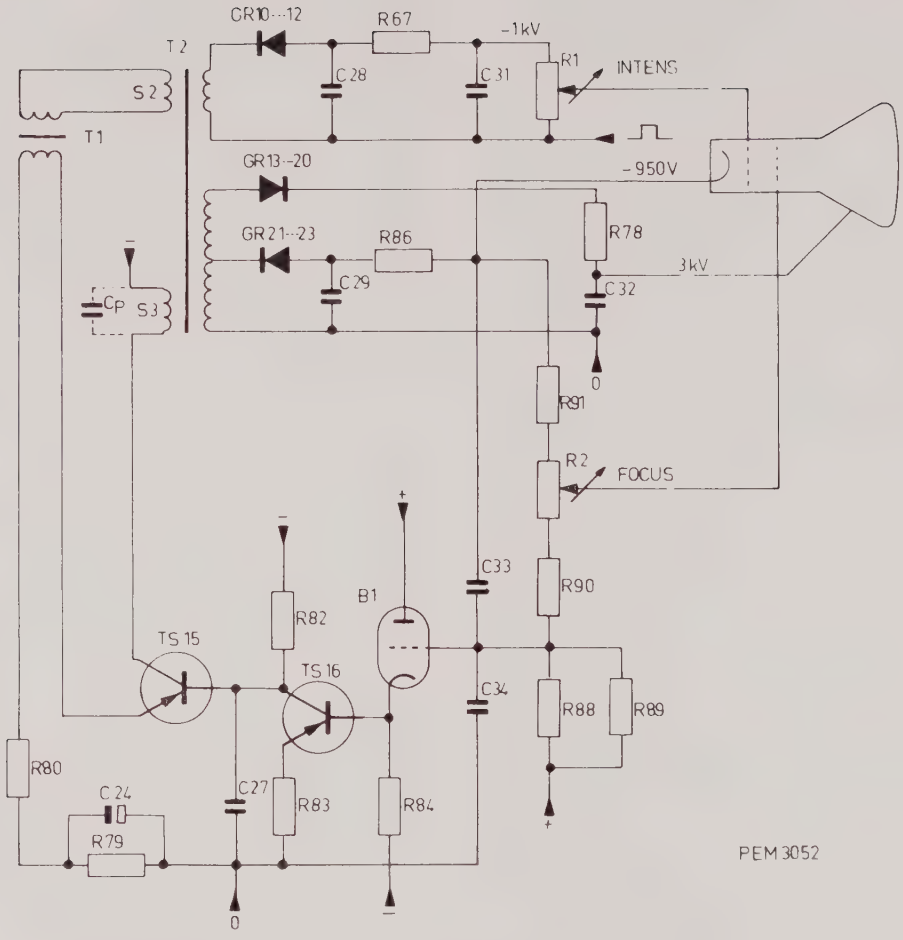


Fig. 9. Simplified diagram of the high voltage unit

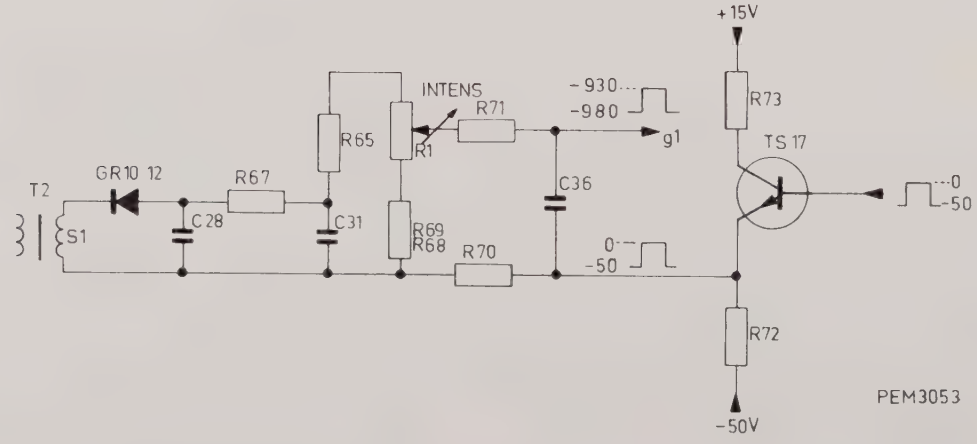


Fig. 10. Simplified diagram of the 1,000 V supply

E. CATHODE RAY TUBE CIRCUIT

L3 is a coil mounted around the cathode ray tube.
A variation of the current through L3 causes a rotation of the trace on the screen. With the aid of R5, by means of which the current through L3 can be varied, the time base line can be adjusted in parallel to the measuring graticule.
The current through coils L4 and L5 can be adjusted with R25.
With the aid of this it can be made sure that the vertical and horizontal deflections are at right angles.
By means of R95, the geometry (barrel and cushion distortion) can be adjusted. R3 serves to adjust the astigmatism and R97 the centring of the electron beam with respect to the deflection system.
To prevent the adjustment of the astigmatism potentiometer from influencing the beam centring, the cursor of R3 is connected to the centre of the Zener diode circuit GR27...GR32.
Fig. 11 clarifies this.

F. CALIBRATION SECTION

The calibration section consists of an astable multivibrator TS13–TS14 delivering a square-wave voltage of 6 V_{p-p}, having a frequency of 1 kHz, to BU1. The level of the top of the calibration voltage is kept at —0.3 V by means of diodes GR4 and GR5.
The 6 V_{p-p} square-wave voltage causes a square-wave current of 6 mA_{p-p} through resistor R62 (1 kΩ) and through the current bracket.
The current bracket is at earth level.
By means of choice capacitor C18 the frequency of the square-wave voltage can be adjusted, while the amplitude can be adjusted with R53 (coarse) and R54 (fine).
The symmetry can be adjusted with R56.

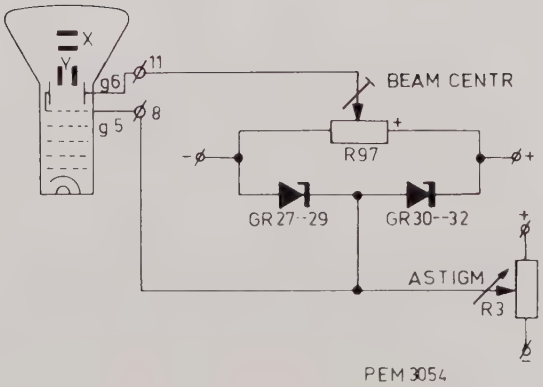


Fig. 11. Beam centring and astigmatism

Gaining access to parts

VIII

A. REMOVING THE PANELS

Top plate
The top plate can be taken off after removing the four fixing screws.

Side plates
Each side plate is secured with two screws

Bottom plate (Fig. 12)
The bottom plate can be taken off after the four rubber feet and the seven screws "A" have been removed.

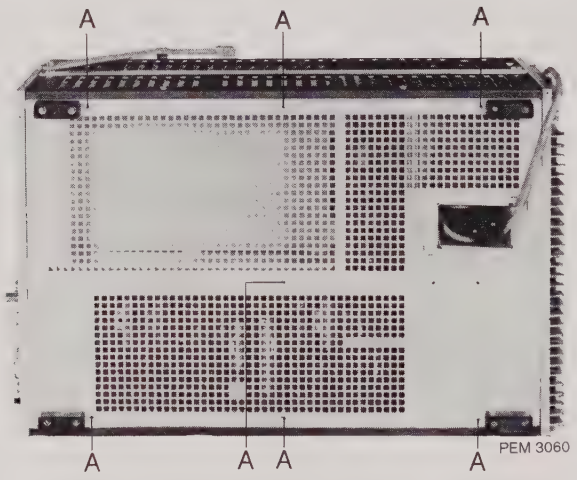


Fig. 12. Bottom view

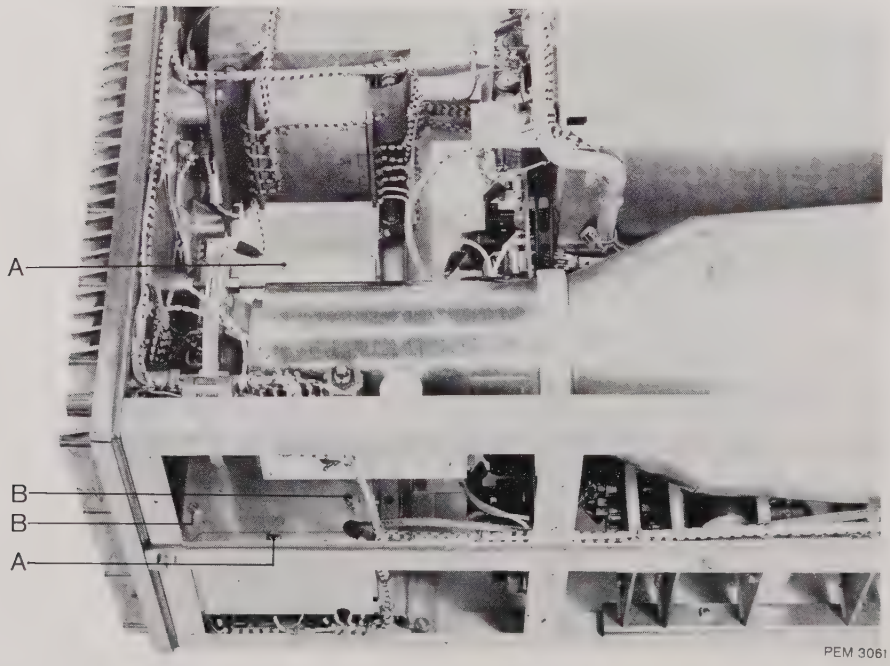


Fig. 13 Gaining access to the high voltage unit

B. GAINING ACCESS TO THE E.H.T. UNIT

- Remove the panelling (see A).
- Remove the two screws "A" and take off the side plates of the E.H.T. unit (see Fig. 13).
- Remove the five screws "B" and take off the top plate of the E.H.T. unit (see Figs. 13 and 14).

If the E.H.T. unit is to be taken out of the instrument, proceed as follows:

- Unsolder the electrical connections at the bottom of the unit.
- Detach the connection cable to the C.R.T.

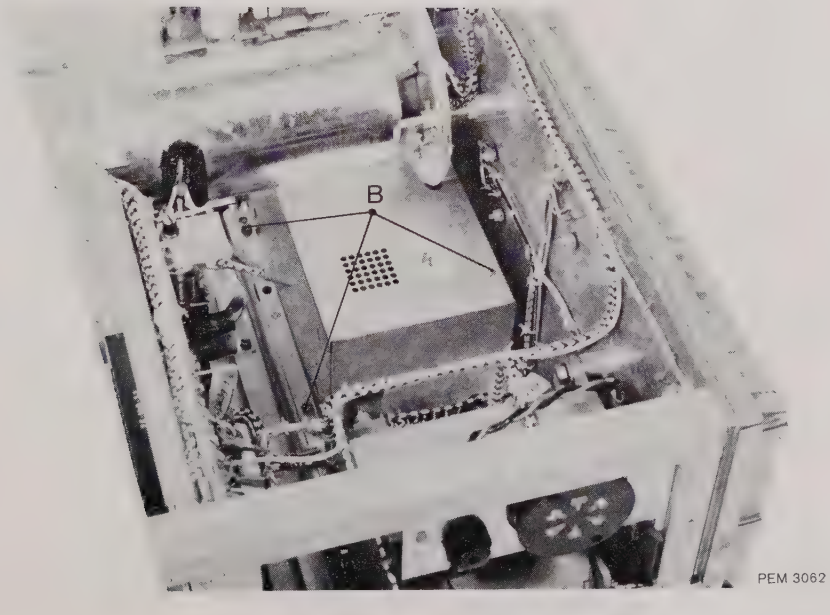


Fig. 14. Gaining access to the high voltage unit

- Remove the six screws "C" (Fig. 15).
- The whole unit can then be taken out at the bottom of the instrument.

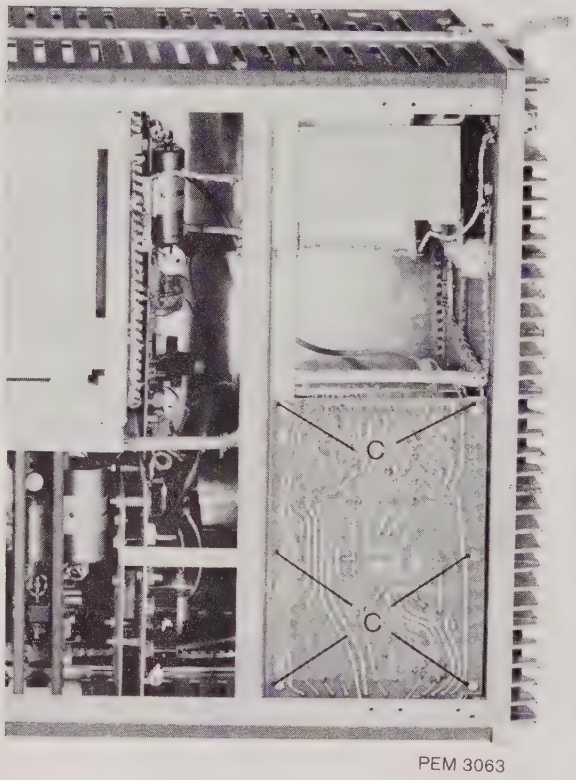


Fig. 15. Gaining access to the high voltage unit

C. REMOVING THE KNOBS (Fig. 16)

- Remove cap "A" with a pointed knife.
- Loosen nut "B".
- Remove the knob.

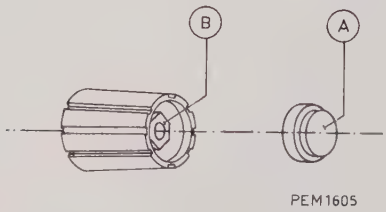


Fig. 16. Removing the knobs

D. REMOVING THE CATHODE RAY TUBE

- Remove the mask, the measuring graticule and the contrast plate.
- Remove all tube connections, i.e. the E.H.T. connection, the five contacts of the deflection electrodes and the connection plug at the base.
- Detach the four wires of the correction coils L4 and L5 at the side of potentiometer R25.
- Detach the two wires of rotation coil L3 from printed wiring plate unit A.
- Pull the C.R.T. forward out of the instrument. Mounting the C.R.T. is effected in reverse order.

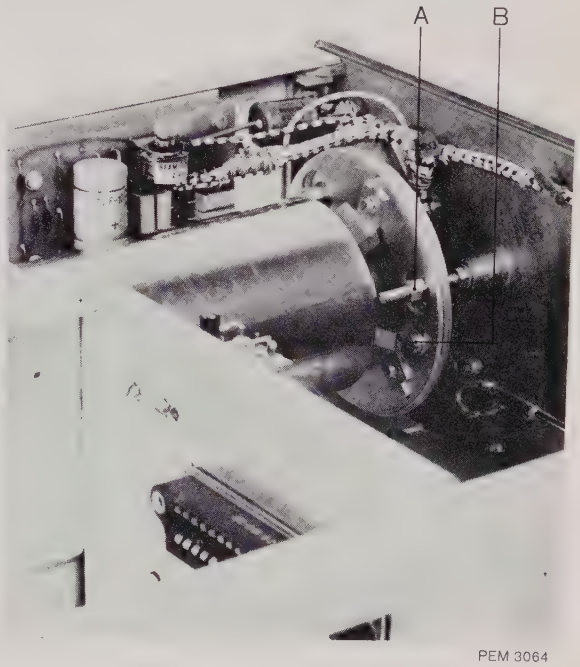


Fig. 17. Mechanical adjustment of the cathode ray tube

After fitting the mask, proceed as follows:

- Slide the tube forward in axial direction as far as possible with the aid of the three threaded ends "A" (Fig. 17).
- Loosen screws "B" (Fig. 17) and move the rear of the tube so that the front of the tube is in parallel with the front plate.

Remark: Rotation coil L3 is mounted around the neck of the C.R.T. with the aid of a rubber ring. Correction coils L4 and L5 can be mounted only by the factory.

E. REMOVING THE PRINTED WIRING BOARDS

1. Units B...H (Fig 18)

- Remove the two screws "R" and with them strip "S".
- The panels can then be pulled out of the instrument.

2. Unit A (Fig 18)

- Remove units B, C and D (see 1).
- Remove cover plate "T".

– Unsolder the soldering connections from the print plate.
– Remove the knobs (see section C).
– Remove the five screws by means of which the print plate is secured to the frame.

3. Unit K (horizontal amplifier)

– Detach the two tube connections.
– Detach the soldering connections.
– Remove the three screws "U" (Fig. 18).
– Take out the print plate at the bottom of the instrument.

4. Unit L (vertical amplifier)

– Detach the two tube connections.
– Detach the soldering connections from the print plate.
– Unsolder the earthing connection "V" (Fig. 19).
– Remove the four screws "W" (Fig. 19).

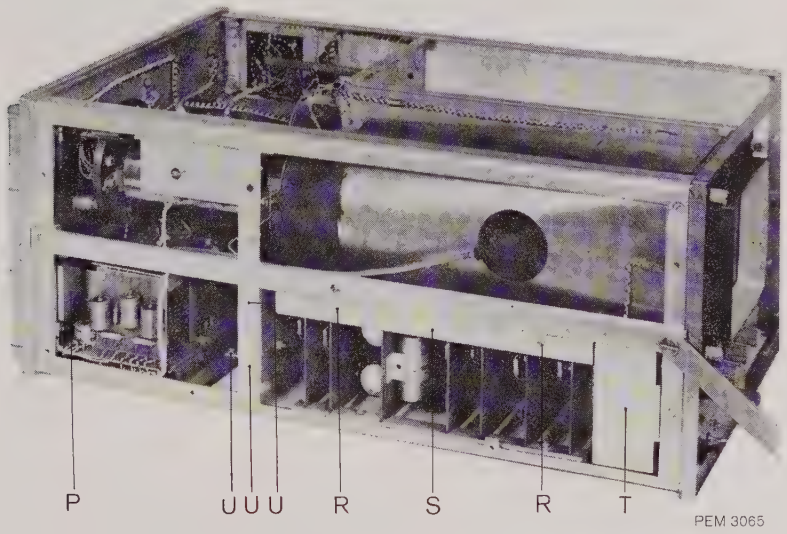


Fig. 18

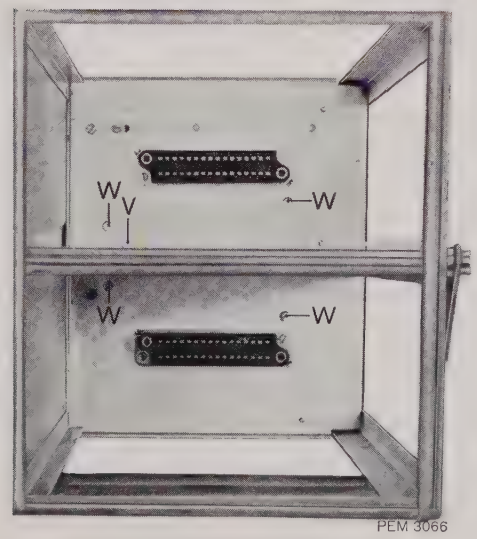


Fig. 19. Gaining access to the print plates

F. GAINING ACCESS TO POWER TRANSISTORS TS15 AND TS111

- Remove the entire E.H.T. unit (see section B).
- Remove plate "P" (Fig. 18) which is secured by means of the two screws "R" (Fig. 20).
- Unsolder the connection wires of the relevant transistor.

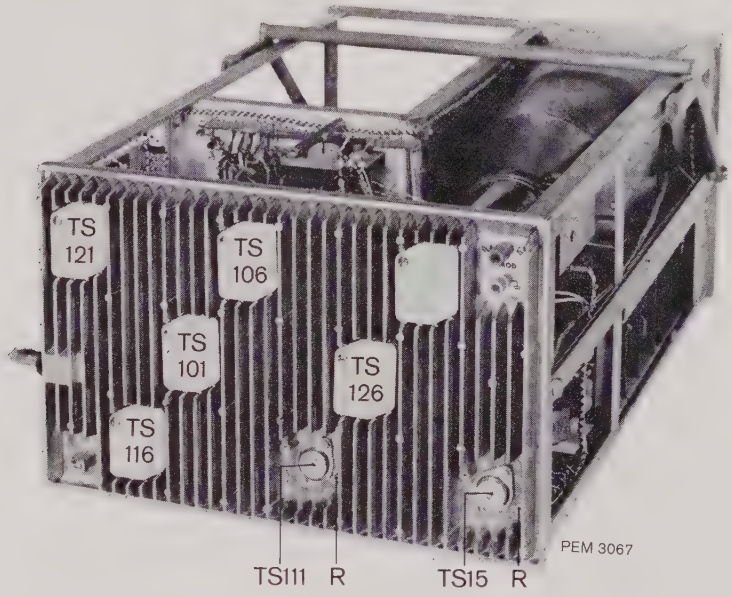


Fig. 20. Gaining access to the power transistors

Survey of adjusting elements and required auxiliary equipment

IX

Adjustment	*Element*	*Measuring instrument*	*Recommended PHILIPS measuring instrument*	*Section of chapter X*
MAINS CURRENT	—	Ammeter	P 817 00	B
SUPPLY VOLTAGES	see table Chapter X.C.	Test unit Oscilloscope	PM 3206	C
HIGH VOLTAGE	R 89	Valve voltmeter	GM 6001	D
CATHODE RAY TUBE CIRCUIT				
Beam centring	R97	—	—	E1
Coordinate axis	R 5, R 25	L.F. Generator	PM 5101	E2
Barrel and cushion distortion	R 95	L.F. Generator	PM 5101 (2×)	E3
Z-modulation	—	Square-wave generator	GM 2324	E4
CALIBRATION VOLTAGE	R 54	Accurately calibrated oscilloscope	PM 3206 (calibrated)	F
HORIZONTAL AMPLIFIER				
Sensitivity	R 9	Test unit		G1
Square-wave reproduction	C 2	Test unit		G2
VERTICAL AMPLIFIER				
Sensitivity	R 36	Test unit		H1
Square-wave reproduction	C15	Test unit		H2

Checking and adjusting

A. GENERAL INFORMATION

Checking and adjusting of the supply voltages and the amplifiers of the PM 3410 can be facilitated with the aid of the avai'able test unit. This plug-in test unit is used in combination with the time base generator PM 3417, when adjusting the amplifiers. The test unit comprises, amongst others, a meter and a connection for an oscilloscope for measuring the ripple of the supply voltages. The built-in square-wave generator delivers an exact symmetrical square-wave voltage having a frequency of 0.5 MHz, an amplitude of 2 × 1.95 V (corresponding to a picture height of 6 cm) and a rise time of < 7 ns.

The tolerances given below are factory tolerances which apply only when the apparatus is readjusted. They may deviate from the data given in chapter II.

B. MAINS CURRENT

- Connect the apparatus to a mains voltage of 220 V, 50 Hz.
- The current taken from the mains should not exceed 350 mA.

C. SUPPLY VOLTAGES

- Insert the test unit into one of the openings of the basic instrument.
- Set switch "High Load" to the upper position (no load).
- Check the supply voltages with the aid of the 6-position switch of the test unit.
- The meter deflection may not exceed ± 0.5%.
- If necessary, adjust the supply voltages according to the following table.

A coarse adjustment is obtained by means of the choice resistors stated between brackets.

Voltage	*Choice resistors*
+100 V	R 163 (R 162) unit D
+ 50 V	R 124 (R 123) unit E
— 50 V	R 111 (R 109) unit G
+ 15 V	R 152 (R 151) unit B
— 15 V	R 138 (R 137) unit C
+ 6.3 V	R 178 (R 177) unit H

- Next, in each position of the test selector, check that the meter variation is less than ± 0.5% in case of a load variation.
  The load variation is effected by means of the appropriate switch on the test unit.
- Next, connect an oscilloscope to the test unit and measure the ripple of the supply voltages. This may not exceed 5 mV_{p-p}.

D. E.H.T.

- Check that the voltage at point 2 (cathode) of the C.R.T. is —950 V, ± 2%.
- If necessary, select a different value for R89 (unit M). Coarse adjustment is effected by means of R88 (unit M).

E. CATHODE RAY TUBE CIRCUIT

1. Beam centring

- Display a time base line.
- Set R2 ("FOCUS") fully counter-clockwise.
- Check that the intensity of the de-focussed line is constant along its entire length.
  Adjusting element R97 ("BEAM CENTR").

2. Position of the coordinate axis

a. With the aid of PM 3417 and PM 3418

- Display a time base line (position "AUT.").
- Check that the time base line runs horizontally.
  Adjusting element R5 ("TRACE ROT.").
- Set the selector switch for horizontal deflection to position "EXT.".
- Apply a sinusoidal voltage to the Y-input.
- Check the vertical position of the trace.
  Adjusting element R25 (Fig. 21).
- Repeat the check.

b. With the aid of PM 3419A and PM 3419B

- Insert the PM 3419A into the lower opening and the PM 3419B in the upper opening of the basic oscilloscope.
- Display a time base line (position "FREE RUN.").
- Check that the time base line runs horizontally.
  Adjusting element R5 ("TRACE ROT.").
- Interchange the plug-in units.
  For this, one of the guide blocks on the rear of each unit must be removed.
- Check the vertical position of the trace.
  Adjusting element R25 (Fig. 21).
- Repeat the check.

3. Barrel and cushion distortion

a. With the aid of the PM 3417 and PM 3418

- Insert the PM 3417 in the upper and the PM 3418 in the lower opening of the basic oscilloscope.
- Apply a sinusoidal signal having a frequency of 50 Hz to the X-input (position "EXT.").

- Apply a sinusoidal signal having a frequency of approximately 100 kHz to the Y-input.
- Adjust to a trace height of 6 cm and a width of 8 cm, symmetrical with respect to the centre of the screen.
- Adjust the barrel and cushion distortion to minimum with R95 ("GEOM.", unit L).

b. With the aid of PM 3419A and PM 3419B

- Insert the PM 3419A in the lower and the PM 3419B in the upper opening of the basic oscilloscope.
- Apply a sinusoidal signal, having a frequency of approximately 100 kHz, to the Y-input.
- Adjust a triggered display with a height of 6 cm and a sweep time of 0.2 µsec/cm.
- Adjust the barrel and cushion distortion to minimum by means of R95 ("GEOM.", unit L). Alternately display the left-hand and the right-hand side of the picture by means of the X-SHIFT control.

4. Z-modulation

- Check the Z-modulation with the aid of a square-wave voltage of 20 V_{p-p}, 1 kHz on BU4 and BU3 ("Z-MOD.").

F. CALIBRATION VOLTAGE

- Check that the amplitude of the square-wave voltage on BU1 ("AMPL. CAL.") is 6 V $\pm$ 0.8%.
- The overshoot should be less than 0.8%.
  Adjusting element R54 (fine) and R53 (coarse), unit A.

G. HORIZONTAL AMPLIFIER

1. Sensitivity

- Insert the test unit into the upper and the time base generator PM 3417 into the lower opening of the basic oscilloscope.
  For this, one of the guide blocks on the rear of each unit must be removed.
- Check that the horizontal deflection is 6 cm.
  Adjusting element R9 (unit K).

2. Square-wave reproduction

- Adjust a triggered display and check the square-wave reproduction.
  Adjusting element C2 (unit K).

H. VERTICAL AMPLIFIER

1. Sensitivity

- Insert the test unit into the lower and the time base generator PM 3417 into the upper opening of the basic oscilloscope.
- Check that the vertical deflection is 6 cm.
  Adjusting element R36, (unit L).

2. Square-wave reproduction

- Adjust a triggered picture and check the square-wave reproduction.
- Adjusting element C15 (unit L).
- Next, check that the rise time of the displayed voltage is $\leq$ 18 ns.

Replacing parts XI

See chapter VII for gaining access to parts.
After replacing parts, it may be necessary to readjust the relevant circuit. The apparatus should be switched off while replacing parts.

A. CATHODE RAY TUBE

After replacing the cathode ray tube, carry out the following checks:

1. Beam centring, coordinate axis, distortion

– Carry out the checks according to chapter X, section E1, 2 and 3.

2. Intensity

– Display a sinusoidal voltage on the screen.
– Set R1 ("INTENS") fully clockwise.
– Check that the voltage across R94, mounted on the base of the C.R.T. does not exceed 3 V.
– If necessary, select a different value for R69 (unit O).
– Turn R1 anti-clockwise and check that the screen becomes dark at scale division 2 or 3 of R1. If necessary, select a different value for R65 (unit A) and repeat the check.

B. FUSES

The instrument is protected by means of fuses VL1 and VL2. VL1 is a thermal fuse mounted on supply transformer T3. Fuse VL2 is located on the right-hand side of the instrument and is accessible after removal of the top plate.

C. PRINTED WIRING BOARDS

1. Unit C (—15 V)

Print plates unit C cannot be ordered from the Central Service Department. As a substitute for unit C, the print plate unit B should be used. On this print plate resistor R153 (22 kΩ) should be replaced by a resistor of 15 kΩ, corresponding to R139 of unit C.

After replacing one of the following panels, the relevant check should be carried out.

2. Unit A

– Connect an oscilloscope to BU1 ("AMPL. CAL.").
– Check that the amplitude of the calibration voltage is 6 V, ± 0.8%. If necessary, select a different value for R54 (fine) or R53 (coarse) unit A.
– Check that the frequency of the calibration voltage is 1,000 Hz, ± 100 Hz. Adjusting element C18 (unit A).
– Check the symmetry of the square-wave voltage. If necessary, adjust with the aid of R56 (unit A) and check the frequency again.

3. Unit K (horizontal amplifier)

– Set R9 to maximum resistance.
– Measure the emitter voltages of TS7 and TS8 with respect to earth.
– Check that the following conditions are met:
$|Ve7 - Ve8| \leq 10\ V.$

$$\frac{Ve7 + Ve8}{2} = 50\ V \pm 1\%$$

– If necessary, adjust with R17 and subsequently readjust R9 according to chapter X.G.1.

4. Unit L (vertical amplifier)

– Set R36 to maximum resistance.
– Measure the collector voltages of TS9 and TS12 with respect to earth.
– Check that the following conditions are met:
$|Vc12 - Vc9| \leq 10\ V$

$$\frac{Vc12 + Vc9}{2} = 50\ V \pm 1\%$$

– If necessary, adjust with R48 and subsequently readjust R36 as described in chapter X.H.1.

D. SEMI-CONDUCTORS

1. TS1 . . . TS8

After replacing one of these transistors, carry out the check described under point C3 for unit K.

2. TS9 . . . TS12

After replacing one of these transistors, carry out the check described under point C4 for unit L.

3. TS121

For transistor TS121 (AU103), always select a transistor having a base leakage current Icbo which is less than 0.3 mA at a collector-emitter voltage Vce of 100 V and at a temperature of 25°C.

4. GR1, GR2 and GR3

For Zener diodes GR1 . . .3, always select such diodes that the sum zener voltage of the three series connected diodes is 18.3 V, ± 0.2 V.

Fault finding

XII

To facilitate fault finding, the d.c. voltages present at various places in the circuit diagrams have been indicated.
These voltages, which merely serve as a guide, have been measured with d.c. valve voltmeter GM 6020.
All leads indicated by a zero in the circuit diagrams have been commonly earthed on the mounting plate on which connection plugs A and B are also mounted. The leads provided with an earthing symbol have been connected to earth via the shortest route.

Remark: In case of breakdowns, one can always apply to the world-wide PHILIPS Service Organisation.
Whenever the instrument is to be sent to a PHILIPS Service Centre for repairs, the following points should be observed:

- tie on a label bearing full name and address of the sender.
- indicate as completely as possible the symptom(s) of the fault(s).
- carefully pack the instrument in the original packing, or if no longer available in a wooden crate.
- send the instrument, **together with two plug-in units,** to the address provided by your local PHILIPS representative.

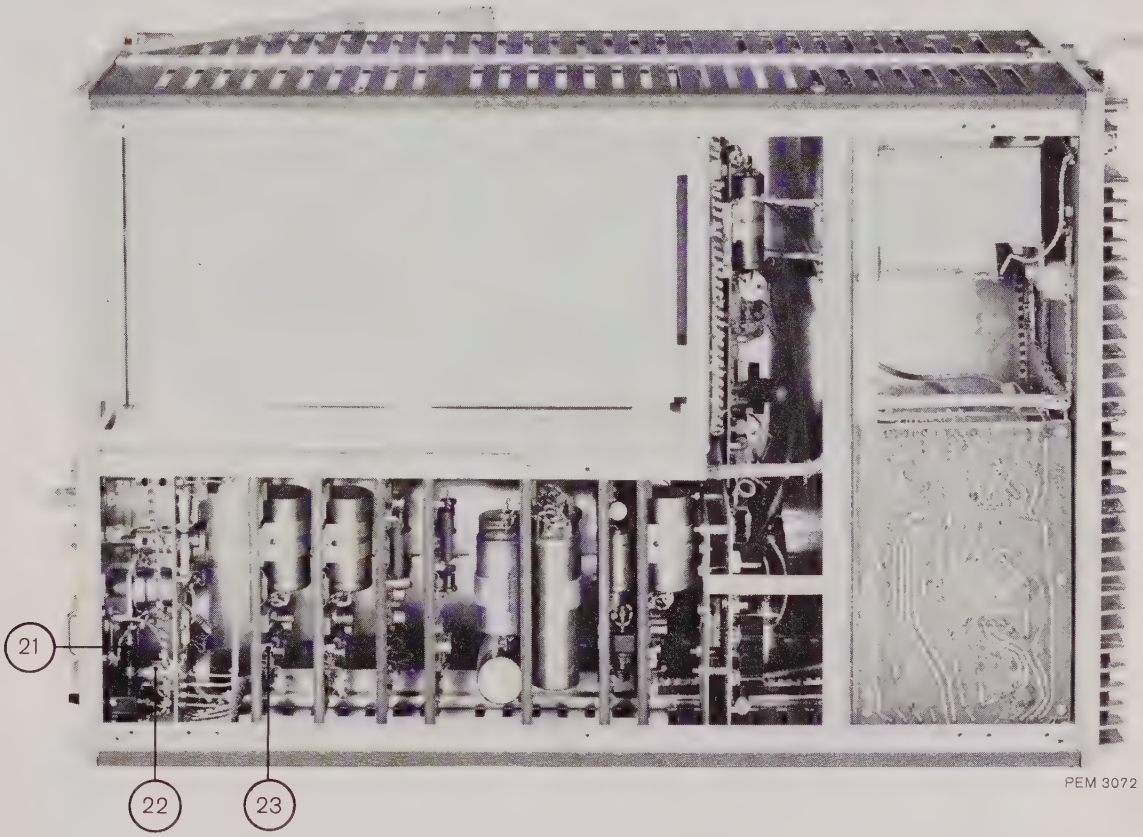


Fig. 25. Bottom view with item numbers

Parts Lists

XIII

A. MECHANICAL PARTS

Item	*Fig.*	*Qty.*	*Code nummer*	*Description*	*„S"*
1	22	1	4822 159 00427	Mask	*
2	22	1	4822 159 00426	Graticule	*
3	22	1	4822 159 00425	Contrast material	**
4	22	4	4822 159 00428	Bolt	**
5	22	4	4822 159 00315	Knob	*
6	22	4	4822 158 00314	Cap	
7	22	1	OD 903 53	Mains switch	*
8	22	2	4822 158 00416	Connection terminal (BU1, 4)	*
9	22	2	4822 158 00366	Connection terminal (BU2, 3)	**
10	22	1	4822 159 00429	Instruction plate	*
11	22	2	4822 157 00732	Lamp holder	*
12	22	2	W4 125 74	Plug socket	*
13	22	4	4822 163 01004	Rubber foot	**
14	23	2	4822 159 00422	Rubber foot (tilting bracket)	**
15	23	1	R 368 KA/05AAO	E.H.T. cable	*
16	23	1	M7 289 49	E.H.T. plug	*
17	23	14	4822 159 00424	Guide strip	*
18	24	3	P7 655 28	Rubber support	*
19	24	1	M7 737 11	Voltage adapter	**
20	24	1	F 101 AA/001	Fuse-holder (VL2)	*
21	25	1	A3 311 15	Pilot lamp holder (LA1)	*
22	25	4	916/06	Coupling socket (for R1...4)	**
23	25	20	959/43	Ceramic tube	**
24	—	7	4822 092 00037	Mica insulation plate for power transistors	*
25	—	16	4822 092 00038	Insolation grommet for power transistors and current bracket	
26	24	1	555 66	Base for C.R.T.	*
27	24	5	555 61	Connection plug for deflection plates C.R.T.	*

Purpose of column "S"

– Components not marked

These components should be present at the Service Department in the relevant country, or in the stock of the customer who is using the instrument.
These include:

a. All electrical components.
b. Mechanical parts which are vulnerable, or which are subject to wear.

– Components marked with one asterisk

These components generally have a long or unlimited service life, but their presence is essential for the correct working of the instrument. Stocking up of a few of these components depends on the following factors:

a. The number of instruments present in the country concerned.
b. The necessity of having the instrument working continuously or not.
c. The time of delivery of the components with respect to the import restrictions in the country concerned and the duration of transport.

– Components marked with two asterisks

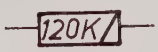
These components have a long or unlimited service life and they are not essential for the correct working of the instrument. Generally they are not stocked locally.

B. ELECTRICAL PARTS

No standard parts are included in this parts list with the exception of choice resistors.
The standard parts in the circuit diagrams (Figs. 40 and 41) are indicated with symbols from which the service code number can be derived.
The key to the code is given below:

	Carbon resistor	0.25 W	≤ 1 MΩ : 5% > 1 MΩ : 10%	902/K...
	Carbon resistor	1 W	≤ 2.2 MΩ : 5% > 2.2 MΩ : 10%	900/P...
	Carbon resistor	0.5 W	≤ 10 MΩ : 1% > 10 MΩ : 2%	901/...
	Carbon resistor	0.5 W	≤ 1.5 MΩ : 5% > 1.5 MΩ : 10%	902/P...
	Wire-wound resistor	5.5 W	≤ 270 Ω : 10% > 270 Ω : 5%	938/A...
	Carbon resistor	0.125 W	5%	902/A...
	Ceramic capacitor	500–700 V		904/...
	Polyester capacitor	400 V	10%	906/...

Example:



Code number 901/120K

Code number 904/4E7

The correct values of the choice resistors and capacitors are determined during factory adjustment. All resistors are vaporised carbon resistors unless otherwise stated.

RESISTORS

Item	Code number	Value		%	W	Description
R1	916/GE1M	1	MΩ			Carbon potentiometer
R2	916/GE2M	2	MΩ			Carbon potentiometer
R3	916/GE100K	100	kΩ			Carbon potentiometer
R4	M7 637 13	30	Ω			Wire wound potentiometer
R5	4822 071 00892	10	kΩ		3	Wire wound potentiometer
R9	4822 071 00656	4.7	kΩ			Carbon potentiometer
R17	902/K...	...		5	0.25	Adjusting range
R23	4822 159 00536	4.7	kΩ		4	Metal oxide resistor
R25	4822 071 00879	2.2	kΩ		3	Wire wound potentiometer
R28, R29, R31	4822 159 00536	4.7	kΩ		4	Metal oxide resistor
R36	4822 071 00657	1	kΩ			Carbon potentiometer
R41, R44	4822 159 00535	750	Ω		6	Metal oxide resistor
R48	902/K...	...		5	0.25	Adjusting range
R52	4822 159 00534	250	Ω		4	Metal oxide resistor
R53	902/K...	...		5	0.25	Adjusting range
R54	902/K...	...		5	0.25	Adjusting range
R56	902/K...	...		5	0.25	Adjusting range
R65	902/K...	...		5	0.25	Adjusting range
R69	902/P...	...		5	0.5	Adjusting range
R80	E 104 AA/A3E9	3.9	Ω		2	Wire wound resistor
R88	902/K...	...			0.25	Adjusting range
R89	902/K...	...			0.25	Adjusting range
R95	4822 071 00693	220	kΩ			Carbon potentiometer
R97	4822 071 00655	47	kΩ			Carbon potentiometer
R103	E 104 AA/A2E2	2.2	Ω		2	Wire wound resistor
R109	902/K...	...		5	0.25	Adjusting range
R111	902/K...	...		5	0.25	Adjusting range
R117	E 104 AA/A2E2	2.2	Ω		2	Wire wound resistor
R123	902/K...	...		5	0.25	Adjusting range
R124	902/K...	...		5	0.25	Adjusting range
R131	E 104 AA/A1E	1	Ω		2	Wire wound resistor
R137	902/K...	...		5	0.25	Adjusting range
R138	902/K...	...		5	0.25	Adjusting range
R144	E 104 AA/A1E	1	Ω		2	Wire wound resistor
R151	902/K...	...		5	0.25	Adjusting range
R152	902/K...	...		5	0.25	Adjusting range
R157	E 104 AA/A2E2	2.2	Ω		2	Wire wound resistor
R162	902/K...	...		5	0.25	Adjusting range
R163	902/K...	...		5	0.25	Adjusting range
R171	E 104 AA/AE56	0.56	Ω		2	Wire wound resistor
R177	902/K...	...		5	0.25	Adjusting range
R178	902/K...	...		5	0.25	Adjusting range

CAPACITORS

Item	*Code number*	*Value*	*V*	*Description*
C2	C 005 AA/25E	25 pF		Trimmer
C3, C5, C6	4822 069 00532	10 nF	30	Plate capacitor
C8, C11	4822 069 01101	47 nF	30	Plate capacitor
C14	4822 069 00532	10 nF	30	Plate capacitor
C18	906/...	...	400	Adjusting range
C22	909/X16	12.5 µF	25	Electrolytic capacitor
C24	909/Z100	100 µF	64	Electrolytic capacitor
C26	4822 069 00933	500 µF	64	Electrolytic capacitor
C27	909/Z100	100 µF	64	Electrolytic capacitor
C28, C29	4822 143 00591	15 nF	1600	Paper capacitor
C30	4822 143 00631	1.8 nF	1600	Paper capacitor
C31	4822 143 00591	15 nF	1600	Paper capacitor
C32	4822 143 00632	1.8 nF	5000	Paper capacitor
C33, C36	4822 143 00591	15 nF	1600	Paper capacitor
C37	4822 069 00612	100 nF	160	Polyester capacitor
C40	4822 143 00591	15 nF	1600	Paper capacitor
C41, C42, C43	4822 069 00612	100 nF	160	Polyester capacitor
C44	4822 069 01083	80 µF	100	Electrolytic capacitor
C46	4822 069 00532	10 nF	30	Plate capacitor
C47	4822 069 00612	100 nF	160	Polyester capacitor
C101	909/Z100	100 µF	64	Electrolytic capacitor
C102	4822 069 00592	80 µF	25	Electrolytic capacitor
C103	4822 069 01005	500 µF	100	Electrolytic capacitor
C106	909/Z10	10 µF	64	Electrolytic capacitor
C107	909/Z100	100 µF	64	Electrolytic capacitor
C108	4822 069 01005	500 µF	100	Electrolytic capacitor
C109	909/Z10	10 µF	64	Electrolytic capacitor
C111	909/Z100	100 µF	64	Electrolytic capacitor
C112	4822 069 00643	1250 µF	25	Electrolytic capacitor
C113	909/W10	10 µF	16	Electrolytic capacitor
C114	4822 069 00903	400 µF	16	Electrolytic capacitor
C116	4822 069 00643	1250 µF	25	Electrolytic capacitor
C117	909/W10	10 µF	16	Electrolytic capacitor
C118	4822 069 00903	400 µF	16	Electrolytic capacitor
C119, C121	4822 069 00932	100 µF	200	Electrolytic capacitor
C123	909/X16	12.5 µF	25	Electrolytic capacitor
C126	4822 069 01031	64 µF	150	Electrolytic capacitor
C127, C128	4822 069 00642	2000 µF	16	Electrolytic capacitor
C129	4822 069 00547	25 µF	6,4	Electrolytic capacitor
C132	909/W125	125 µF	10	Electrolytic capacitor

PRINTED WIRING BOARDS WITH PARTS

Unit	Code number	Description
A*	4822 159 00537	Calibration generator and front plate potentiometers
B	4822 159 00538	+ 15 V supply print
C	See chapter XI-C1	— 15 V supply print
D	4822 159 00539	+100 V supply print
E	4822 159 00541	+ 50 V supply print
G	4822 159 00542	— 50 V supply print
H	4822 159 00543	+ 6,3 V supply print
K*	4822 159 00544	Horizontal output amplifier
L*	4822 159 00545	Vertical output amplifier
M	4822 159 00546	High voltage prints
N	4822 159 00547	
O	4822 159 00548	
P	4822 159 00549	
R	4822 159 00551	40 V supply print for beam centring
J	4822 159 00552	Wiring print

* See also chapter XI-C

SEMI-CONDUCTORS AND VALVES

Item	Type	Description
TS1*	AF118	Transistor
TS2*	AF118	Transistor
TS3*	BF109	Transistor
TS4*	BSY39	Transistor
TS5*	BSY39	Transistor
TS6*	BF109	Transistor
TS7*	BF109	Transistor
TS8*	BF109	Transistor
TS9*	BFY44	Transistor
TS10*	BSY39	Transistor
TS11*	BSY39	Transistor
TS12*	BFY44	Transistor
TS13	BF109	Transistor
TS14	BF109	Transistor
TS15	AU103	Transistor
TS16	ASY27	Transistor
TS17	BF109	Transistor
TS101	AU103	Transistor
TS102	BCY40	Transistor
TS103	AC126	Transistor
TS104	BCY32S	Transistor
TS105	BCY32S	Transistor
TS106	AU103	Transistor
TS107	BCY40	Transistor
TS108	AC126	Transistor
TS109	BCY32S	Transistor
TS110	BCY32S	Transistor
TS111	ASZ15	Transistor
TS112	AF118	Transistor
TS113	AC126	Transistor
TS114	BCY32S	Transistor
TS115	BCY32S	Transistor
TS116	ASZ15	Transistor
TS117	AF118	Transistor
TS118	AC126	Transistor
TS119	BCY32S	Transistor
TS120	BCY32S	Transistor
TS121*	AU103	Transistor
TS122	BCY32S	Transistor
TS123	AC126	Transistor
TS124	BCY32S	Transistor
TS125	BCY32S	Transistor
TS126	ASZ15	Transistor
TS127	BCY40	Transistor
TS128	AC126	Transistor
TS129	AC126	Transistor
TS130	BCY32S	Transistor
TS131	BCY32S	Transistor
GR1*	BZY58	Zener diode
GR2*	BZY58	Zener diode
GR3*	BZY58	Zener diode
GR4	AAZ18	Germanium diode
GR5	AAZ18	Germanium diode
GR6	BY100S	Silicon diode
GR7	BY100S	Silicon diode
GR8	BY100S	Silicon diode
GR9	BY100S	Silicon diode
GR10	BYX10	Silicon diode
GR11	BYX10	Silicon diode
GR12	BYX10	Silicon diode
GR13	BYX10	Silicon diode
GR14	BYX10	Silicon diode
GR15	BYX10	Silicon diode
GR16	BYX10	Silicon diode
GR17	BYX10	Silicon diode
GR18	BYX10	Silicon diode
GR19	BYX10	Silicon diode
GR20	BYX10	Silicon diode
GR21	BYX10	Silicon diode
GR22	BYX10	Silicon diode
GR23	BYX10	Silicon diode
GR24	AAY11	Germanium diode
GR26	BZY65	Zener diode
GR27	BZY61	Zener diode
GR28	BZY61	
GR29	BZY61	
GR30	BZY61	
GR31	BZY61	
GR32	BZY61	

* See also chapter XI-D

Item	*Type*	*Description*
GR33	BY100S	Silicon diode
GR101	BY100S	Silicon diode
GR102	BZZ27	Zener diode
GR103	BY100S	Silicon diode
GR104	BY100S	Silicon diode
GR105	BY100S	Silicon diode
GR106	BY100S	Silicon diode
GR107	BZY56	Zener diode
GR108	BZY58	Zener diode
GR109	BY100S	Silicon diode
GR110	BY100S	Silicon diode
GR111	BY100S	Silicon diode
GR112	BY100S	Silicon diode
GR113	BZY56	Zener diode
GR114	BZY58	Zener diode
GR115	BY100S	Silicon diode
GR116	BY100S	Silicon diode
GR117	BY100S	Silcon diode
GR118	BY100S	Siliicon diode
GR119	BZY56	Zener diode
GR120	BZY58	Zener diode
GR121	BY100S	Silicon diode
GR122	BY100S	Silicon diode
GR123	BY100S	Silicon diode
GR124	BY100S	Silicon diode
GR125	BZY56	Zener diode
GR126	BZY58	Zener diode
GR127	BY100S	Silicon diode
GR128	BY100S	Silicon diode
GR129	BY100S	Silicon diode
GR130	BY100S	Silicon diode
GR131	BZY60	Zener diode
GR132	BYX20/200	Silicon diode
GR133	BYX20/200R	Silicon diode
GR134	BYX20/200	Silicon diode
GR135	BYX20/200R	Silicon diode
GR136	BZY56	Zener diode
B1	5718	Miniature valve
B2	D14-10GH	Cathode ray tube
B101	ZZ 1000	Neon tube

MISCELLANEOUS

Item	*Code number*	*Value*	*Description*
T1	4822 159 00479		Transformer
T2	4822 142 60096		High voltage transformer
T3	4822 159 00484		Supply transformer
L1, L2	4822 159 00485	2,9—4 µH	Coil
L3	4822 157 50212		Rotation coil
VL1	974/T125	125 °C	Thermal fuse
VL2	974/V1000	1A	Fuse
	974/V2000	2A	
LA1	8034D	10V/0.2A	Pilot lamp
LA2, LA3	6828	6V/0.1A	Graticule illumination lamp
—	4822 159 00561		Extension print plate for units B, C, E, F, G and H
—	4822 159 00562		Extension print plate for unit D
—	4822 395 30015		Test unit for checking and adjusting the PM 3410

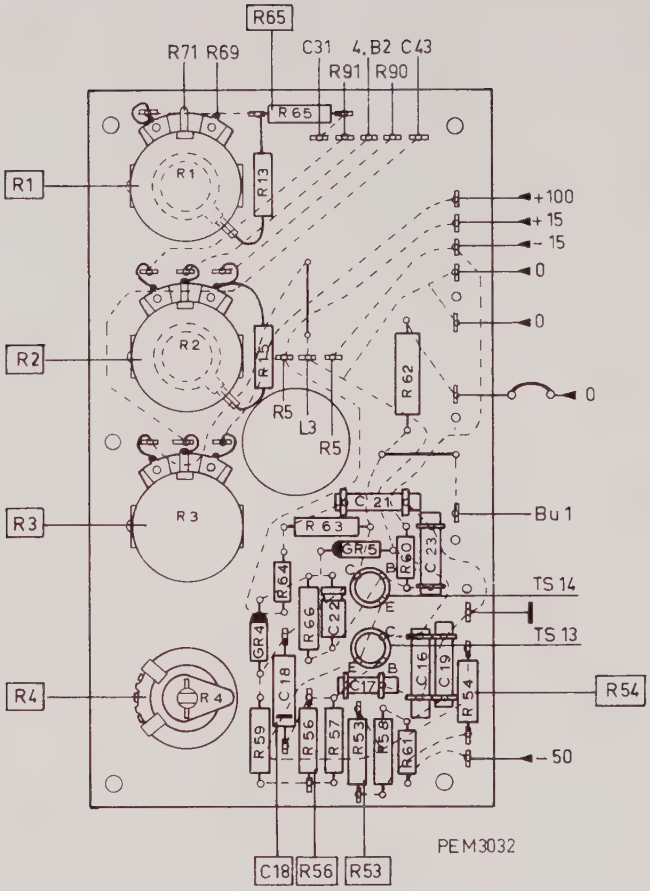


Fig. 26.
Unit A print plate, calibration generator

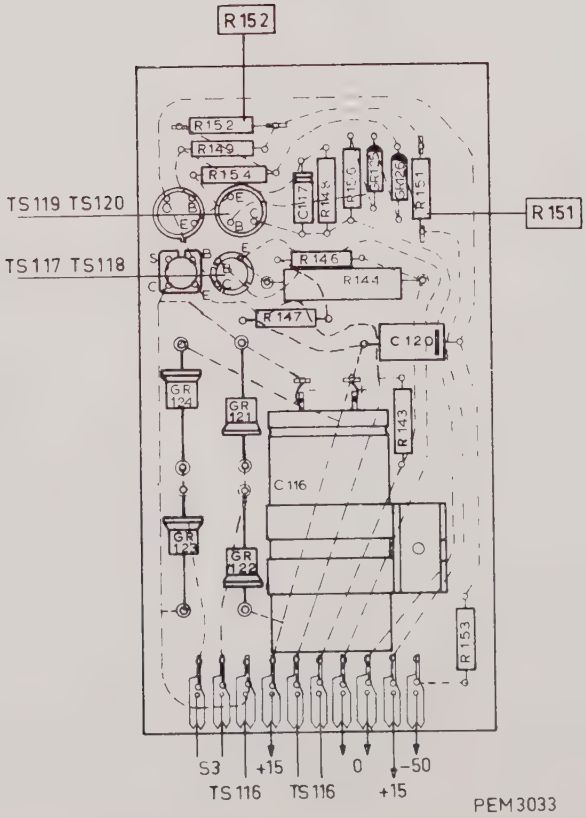


Fig. 27.
Unit B print plate, + 15 V

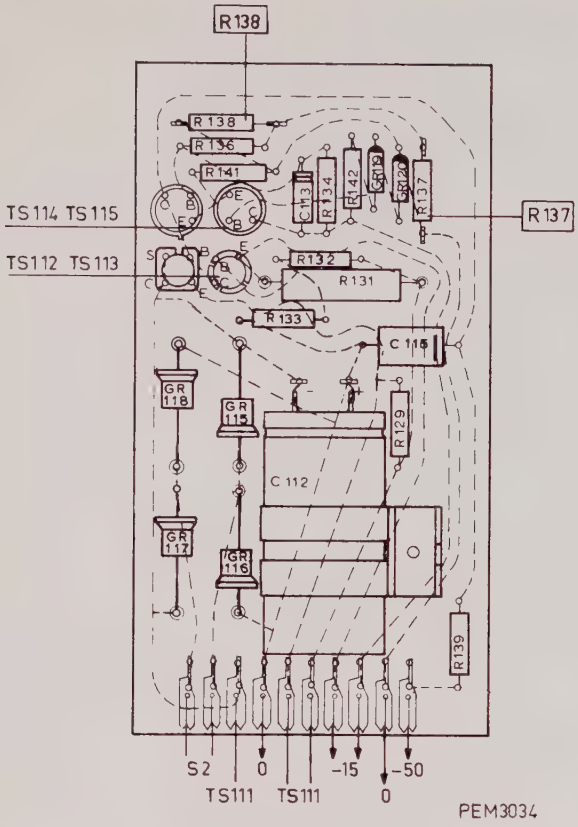


Fig. 28. Unit C print plate, —15 V

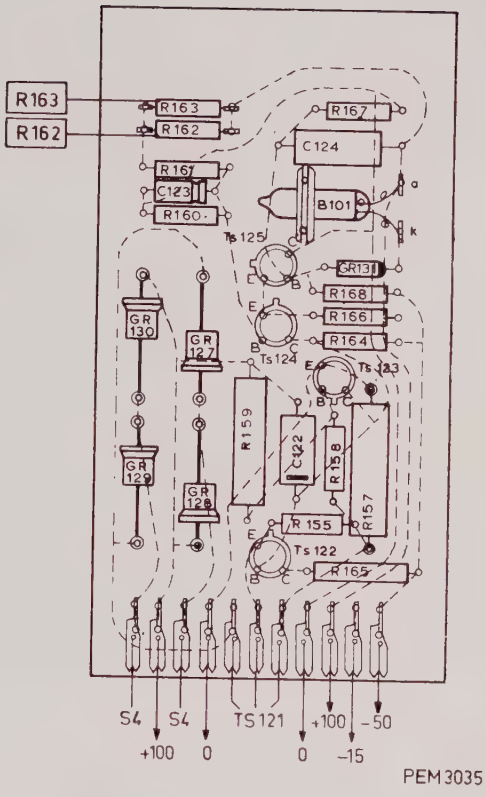


Fig. 29. Unit D print plate, +100 V

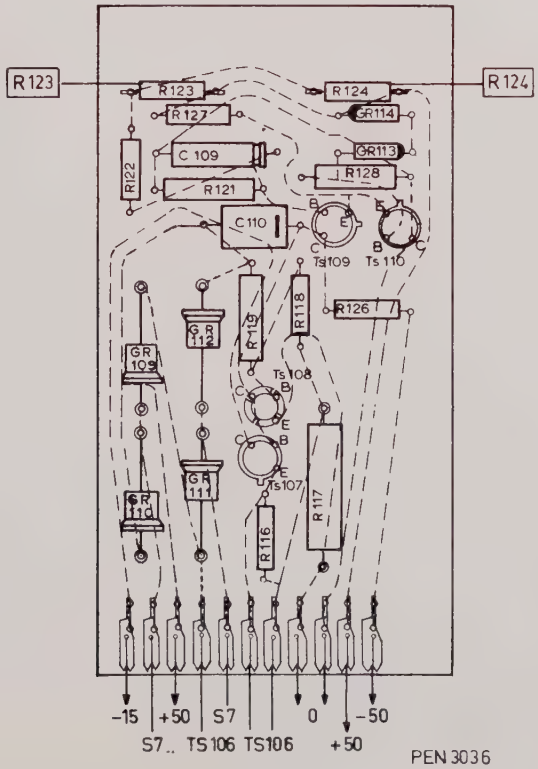


Fig. 30. Unit E print plate, +50 V

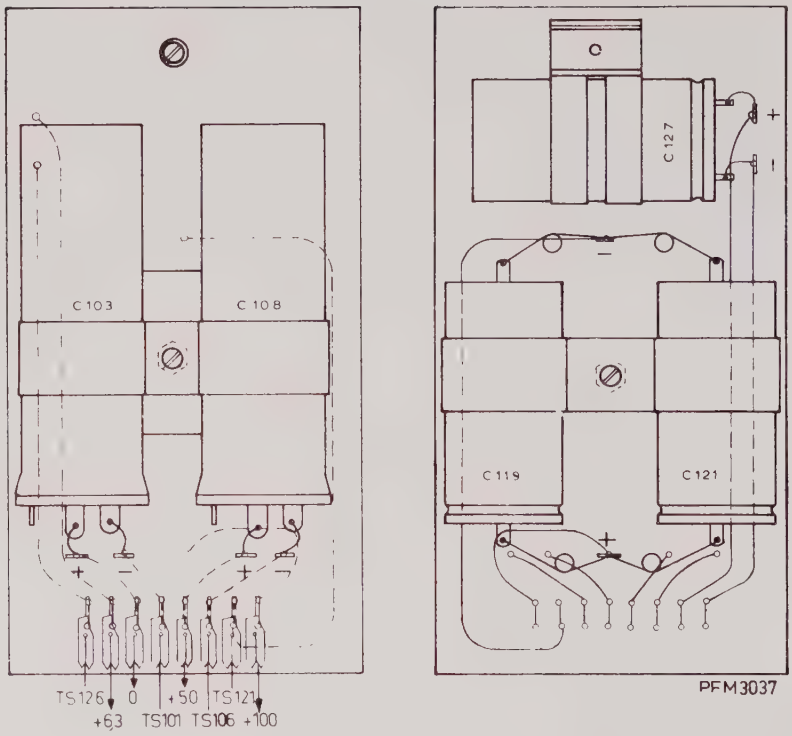


Fig. 31. Unit F print plate,

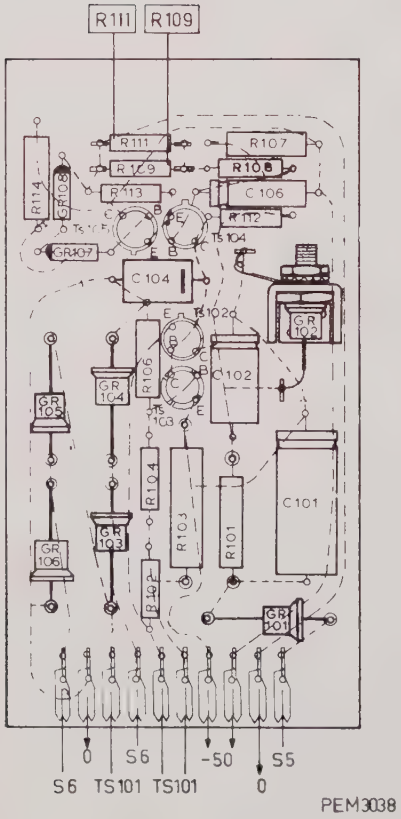


Fig. 32. Unit G print plate, —50 V

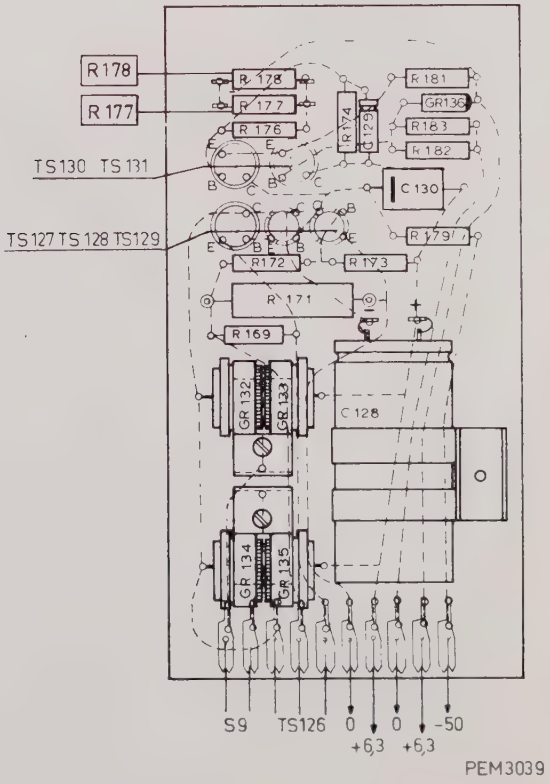


Fig. 33. Unit H print plate, +6.3 V

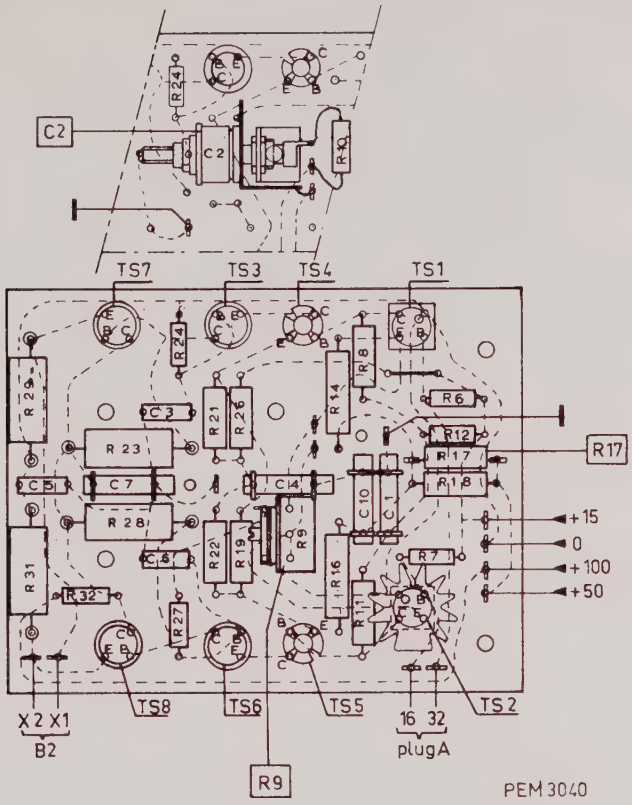


Fig. 34.
Unit K print plate,
X-amplifier

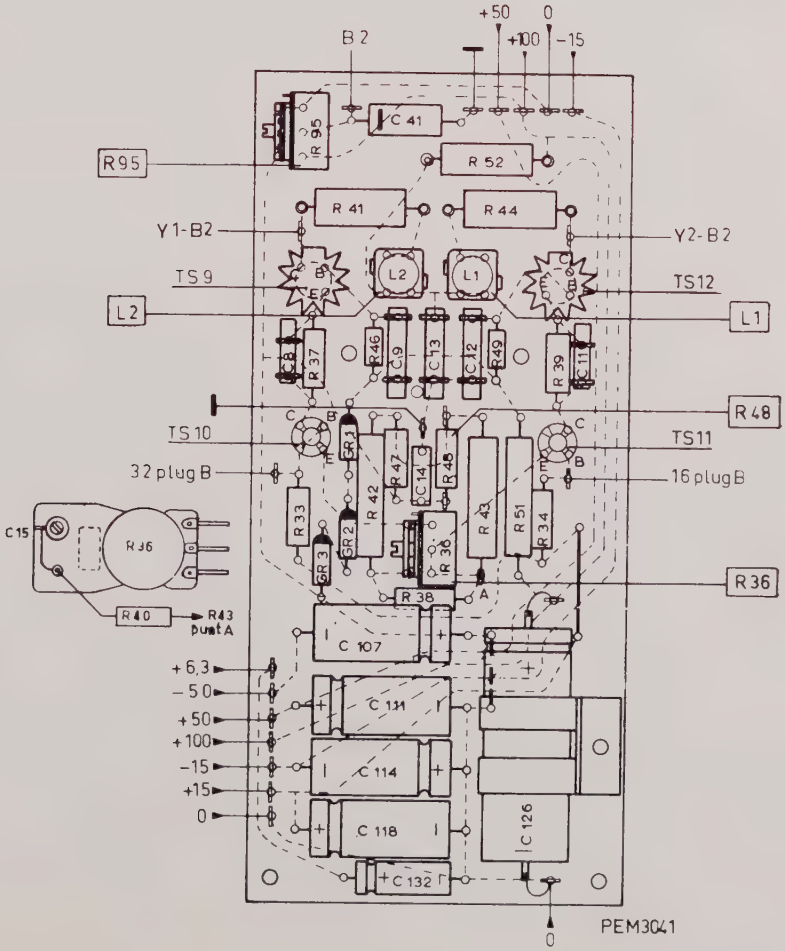
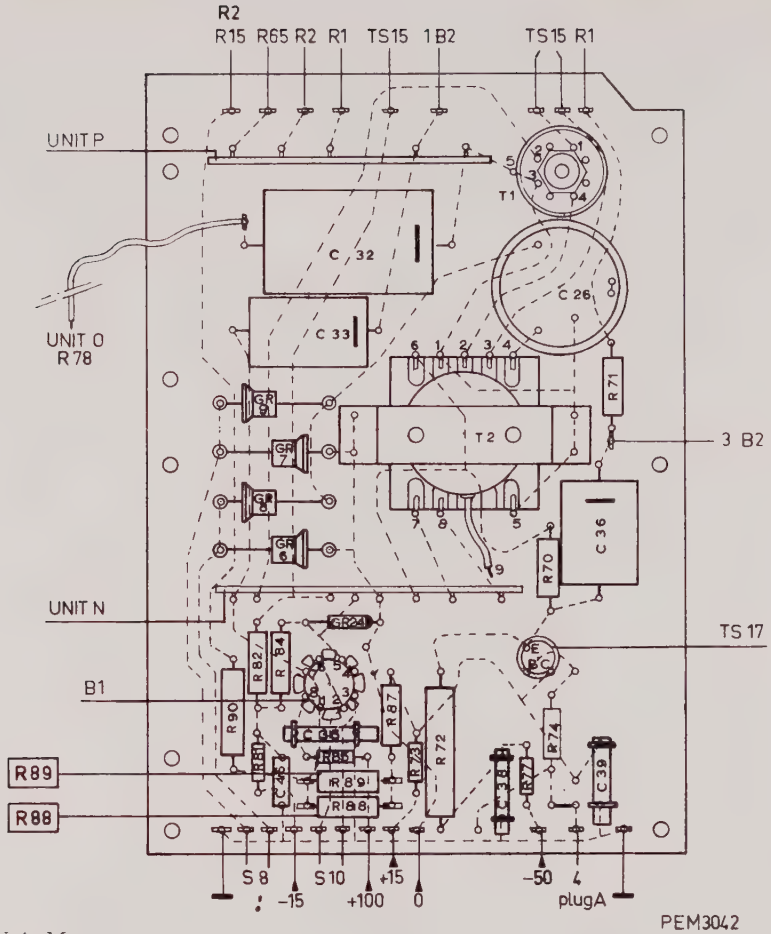
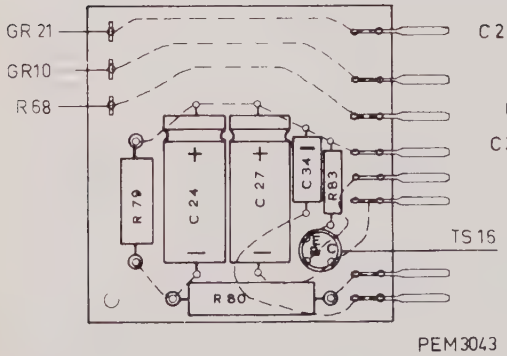


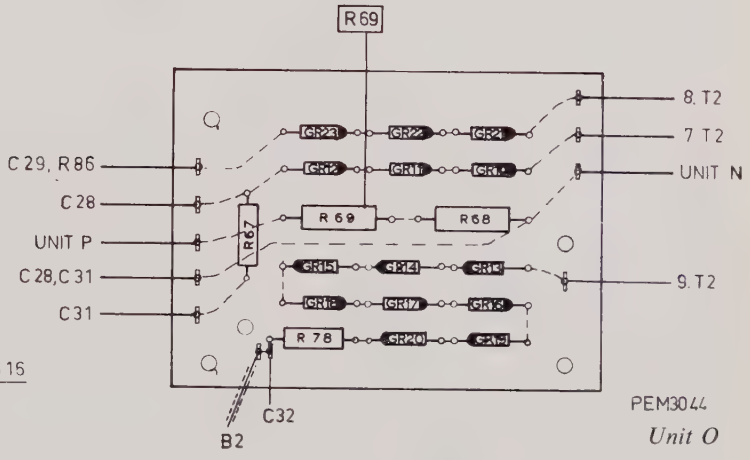
Fig. 35.
Unit L print plate,
Y-amplifier



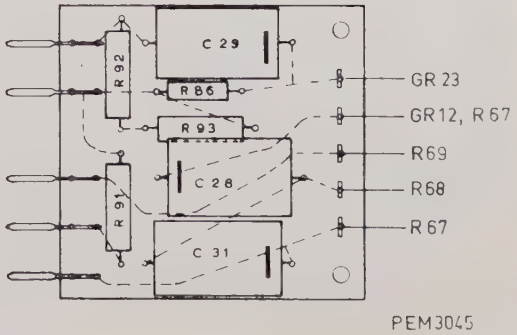
Unit M



Unit M



Unit O



Unit P

Fig. 36.
Units M, N, O, P print plates, high voltage

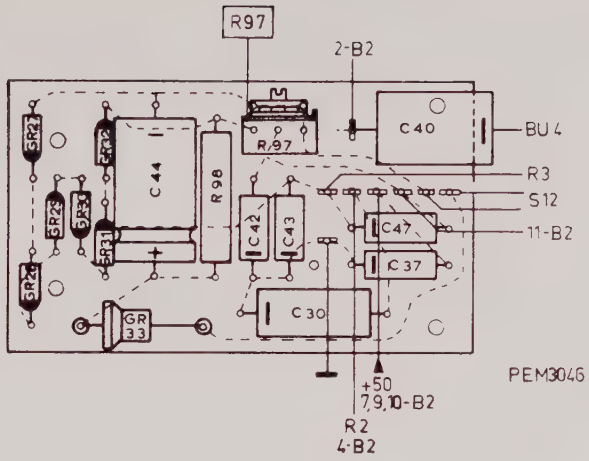


Fig. 37.
Unit R print plate, beam centring

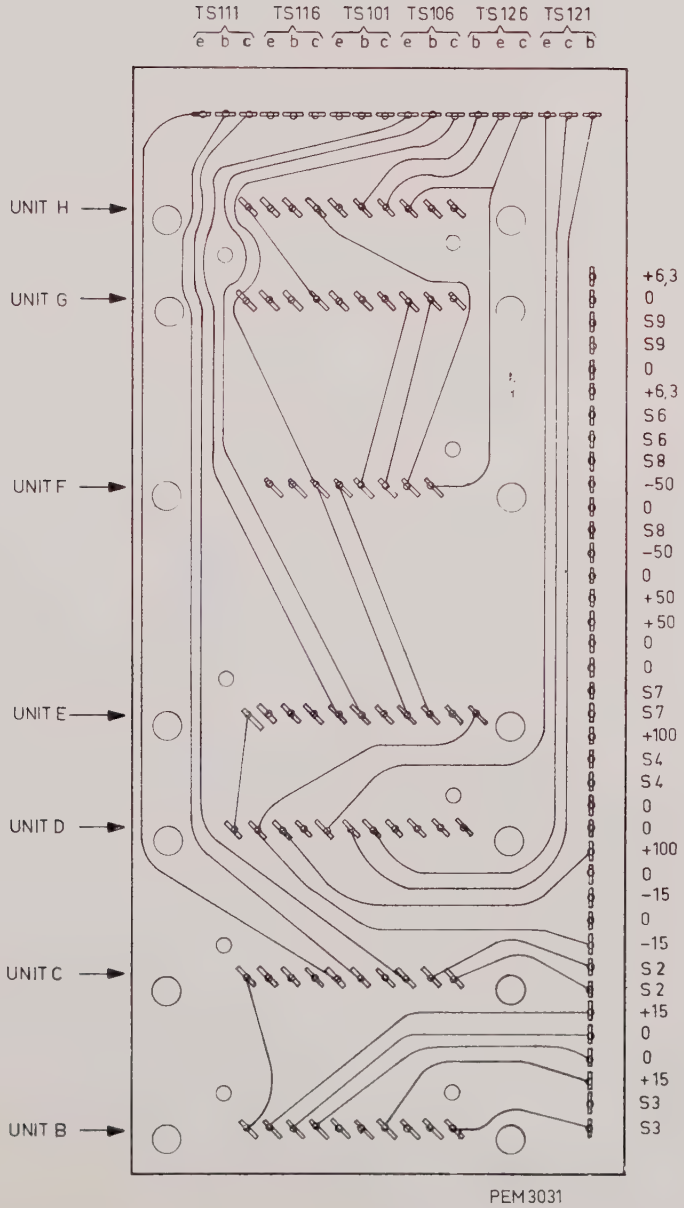
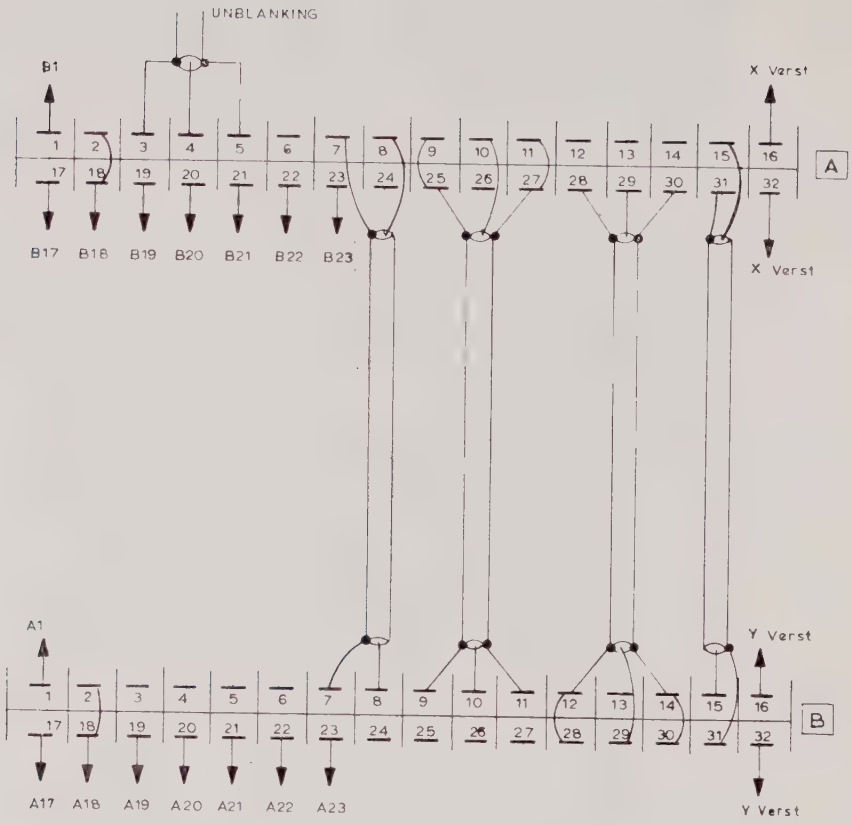


Fig. 38.
Unit J, wiring print plate



A 2 = A 18 = B 2 = B 18 = 0
A 17 = B 17 = + 15 Volt
A 19 = B 19 = - 15 Volt
A 20 = B 20 = +100 Volt
A 21 = B 21 = + 50 Volt
A 22 = B 22 = - 50 Volt
A 23 = B 20 = + 6,3 Volt
A 1 = B 1 = 6,3 Volt

Fig. 39. Connections of plugs A and B

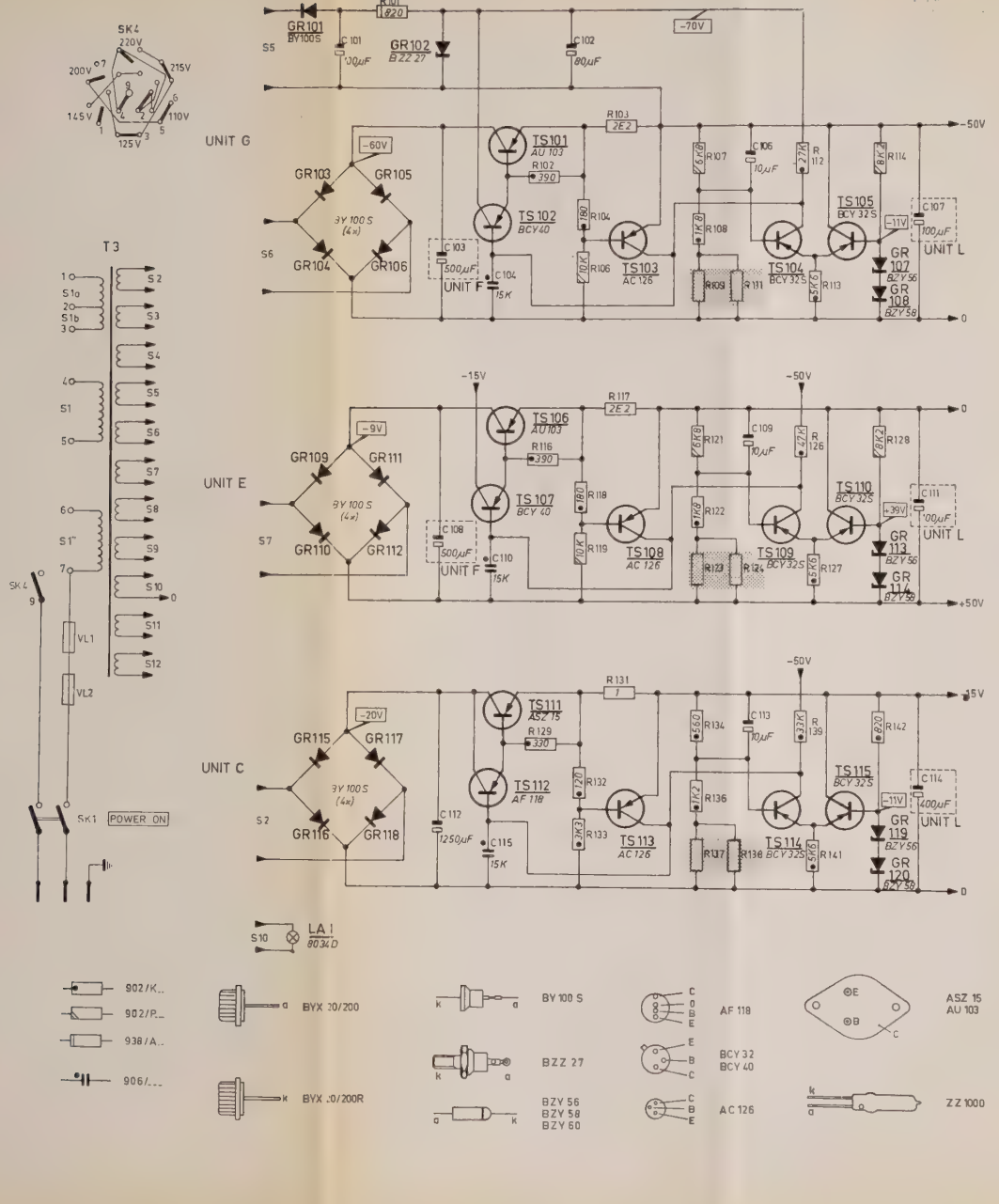


Fig. 40. Circuit diagram, supply section

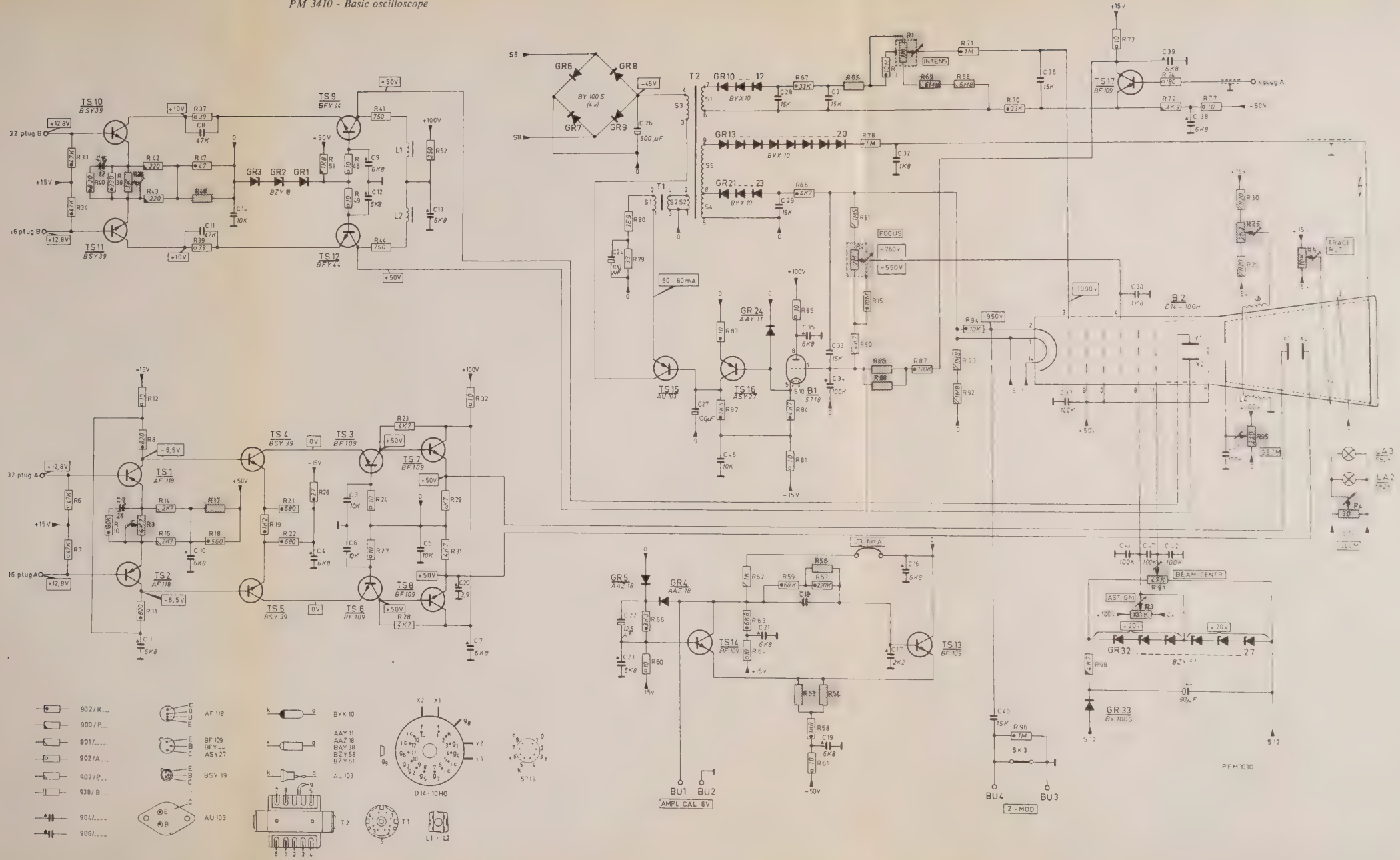


Fig. 41. Circuit diagram, PM 3410

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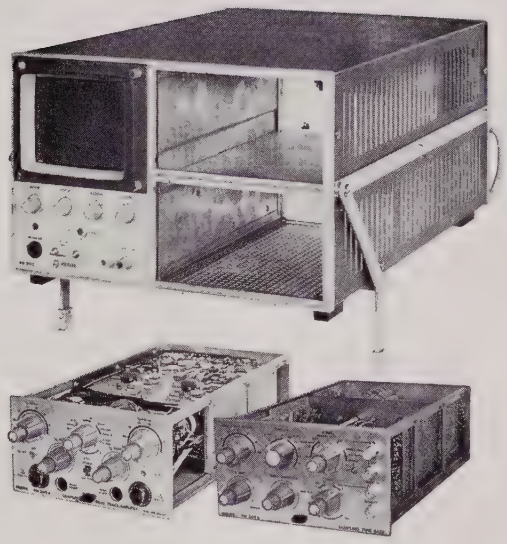

Operating manual

PM 3419A + PM 3419B — Sampling plug-in units

66 405 51.1-10 1/666

IMPORTANT:

In correspondence concerning these instruments, please quote the type number and the serial number as given on the type plate on the rear of the instruments.

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General

I

The sampling system consists of two plug-in units i.e. the sampling dual trace amplifier PM 3419 A and the sampling time base unit PM 3419 B. The amplifier unit should be plugged into the lower and the time base unit into the upper opening of the basic instrument.

The technical data and the directions for use will be given in this operating manual, while the information for service purposes in given, for each unit separately, in the PM 3419 A and PM 3419 B service manuals.

Technical data

II

Tolerances quoted, in the following data are guaranteed by the factory for a nominal mains voltage. Values without tolerances serve only for information purposes and indicate the properties of an average instrument.

A. PM3419 A, SAMPLING AMPLIFIER

Mode of operation

1. Channel A only
2. Channel B only
3. Channel A and channel B
4. Channel A and inverted channel B
5. Channel A plus channel B
6. Channel A minus channel B
7. Channel A vertical and channel B horizontal.

Rise time

0.35 ns or less, with less than 3% overshoot and undershoot.

Frequency response

Equivalent to DC–1000 MHz

Sensitivity

8 calibrated ranges, 1 mV/cm to 200 mV/cm in 1–2–5 sequence. A variable control permits uncalibrated, continuous adjustment between ranges.

Attenuator tolerance

± 3%

Noise

Less than 2 mV with NORMAL-SMOOTHED switch in NORMAL position and less than 1 mV in SMOOTHED position. Automatic smoothing in the 1 and 2 mV/cm positions.
(Noise measured as 3× rms, or as observed signal excluding 10% of random dots).

Isolation between channels

More than 40 dB up to 1000 MHz.

Input impedance

50 ohms. Input connectors are GR 874 (locking type).

Signal delay

35 ns delay time for each channel permits viewing leading edge of input waveform.

Dynamic range

1.6 volts. (= Full scale reading). Small signals on top of DC-levels up to ± 1.6 volts can be viewed at any sensitivity.

Maximum input voltage

± 5 volts DC. (Higher with reduced duty factor and pulse slope of less than 3 volts/ns).

Internal trigger

Triggering can be selected from either channel. The trigger take-offs deliver approximately 1/9 of the input signal amplitude to the timing unit.

Recorder output (Y OUT)

Channel A and channel B. Output amplitude is 0.5 V/cm through 1 kΩ. 4 mm banana plug socket.

Probe power Connectors on both channels for cathode follower probe.

Dimensions
Height: 10.5 cm (4″)
Width: 19 cm (7 1/2″)
Depth: 32 cm (12 1/2″)

Weight 5 kg (11 lb)

B. PM3419 B, SAMPLING TIME BASE UNIT

Sweep speed 13 calibrated ranges, 1 ns/cm to 10 μs/cm in 1–2–5 sequence. Tolerance is ± 3%.

Magnification 7 calibrated ranges, ×1 to ×100 in 1–2–5 sequence. A variable control permits uncalibrated, continuous adjustment between ranges. Intensity and sample density remain constant when display is magnified. Tolerance within ± 5% at all magnifier settings.

X Shift Coarse and fine controls provide horizontal shift of one unmagnified screen width.

X Deflection
1. Repetitive with 10, 100 or 1000 samples/cm.
2. Manual scan, using front panel control.
3. External scan by external voltage via continuous attenuator with 10 kΩ input impedance.
   Min. 5 V is needed for 10 cm deflection.
4. Single adj. with repetitive internal slow ramp with sweep time adjustable from 1 to 60 s per sweep.
5. Single with internal slow ramp with sweep time adjustable from 1 to 60 s per sweep.
   (The sweep time set in ″Single adj.″ mode will be operative in ″Single″ mode).

Recorder output (X OUT) 0.5 V/cm deflection on the screen through 1 kΩ. BNC-connector.

Trigger modes Internal +, internal —, external +, external — and free run.

Amplitude range 5 mV to 250 mV peak to peak for external trigger. Nine times more internal trigger amplitude is required. Safe overload ± 5 V peak.

Pulse width More than 1 ns at minimum amplitude.

Frequency range Up to 1000 MHz.

Jitter Less than 30 ps or 2 mm with sweep magnified 100 times, which ever is greater. This is for fast rise signals and 50 mV or more amplitude on the external input.

Trigger output
Pulse amplitude: Approximately +2 volts into 50 kΩ.
Pulse rise time: Less than 4 ns.
Pulse width: Approximately 35 ns.

Dimensions
Height: 10.5 cm (4″)
Width: 19 cm (7 1/2″)
Depth: 32 cm (12 1/2″)

Weight 1.6 kg (3 1/2 lb)

Optional accessories

Note: For spare parts see chapter VI.C

A. PM 9340 (See Fig. 8)
Cathode follower probe

1. Introduction

The PM 9340 HF cathode follower measuring probe is used in conjunction with the PM 9341 set of slip-on accessories.

2. Provisional electrical data of the cathode follower probe and the slip-on attenuators

a. The slip-on attenuators allow the following attenuations to be obtained.

×10, ×20, ×50, ×100, ×200, ×500 and ×1000, according to table I.
The permissible voltage at higher frequencies is lower where continuous wave is used. See table II.

b. Cathode follower measuring probes are fed from PM 3419 A amplifier unit.

6.3 V – 180 mA
70 V – 12 mA

c. Valves used

Triode: EC 1000
Diode: BAY 38

TABLE I

Attenuation	*Input resistance* ± 2%	*Input capacitance* ± 10%	*Rise time*	*Equivalent characteristic bandwidth*	*Max. permissible voltage*
× 10	10 MΩ	3.6 pF	0.4 nsec	0–850 MHz	1.5 V
× 20	10 MΩ	2.6 pF	0.4 nsec	0–850 MHz	3 V
× 50	10 MΩ	1.8 pF	0.4 nsec	0–850 MHz	7.5 V
× 100	10 MΩ	1.5 pF	0.4 nsec	0–850 MHz	15 V
× 200	10 MΩ	1.4 pF	0.4 nsec	0–850 MHz	30 V
× 500	10 MΩ	1.3 pF	0.4 nsec	0–850 MHz	75 V
×1000	10 MΩ	1.3 pF	0.4 nsec	0–850 MHz	150 V

TABLE II

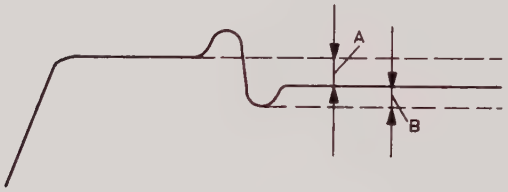
	Max. permissible voltage			
Attenuation	500 *MHz*	750 *MHz*	1000 *MHz*	1250 *MHz*
× 500	150 V_{p-p}	150 V_{p-p}	150 V_{p-p}	125 V_{p-p}
×1000	300 V_{p-p}	200 V_{p-p}	150 V_{p-p}	125 V_{p-p}

B. PM 9341 (See Fig. 9)

Slip-on accessories for the cathode follower probe consisting of:

a. slip on attenuators (Fig. 9-5) × 10, × 20, × 50, × 100, × 200, × 500, × 1000 } The attenuation of the cathode follower probe is included

b. slip-on coupling capacitor (Fig. 9-4)
c. earth clip (short) (Fig. 9-1)
d. earth clip (long) (Fig. 9-3)
e. terminal spring (Fig. 9-2)
f. box for storing items *a* to *e* as well as two PM 9340 cathode follower probes.



PEM 3252

Fig. 1. Pulse reflection
A = real component
B = imaginary component

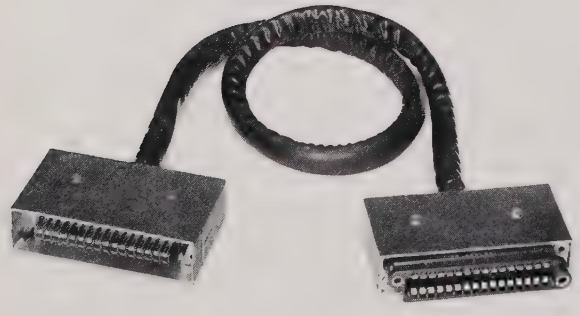


Fig. 2. Extension cable

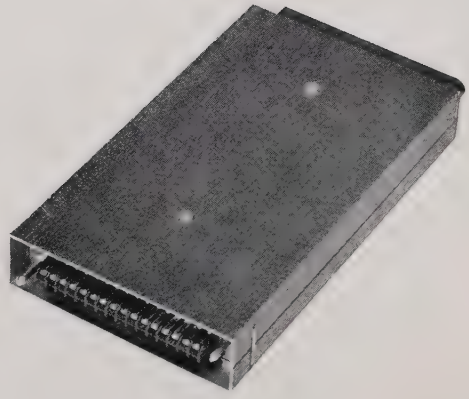


Fig. 3. Extension plug

C. PM 9342 (See Fig. 11)

1 : 10 attenuator consisting of:

a. attenuator probe with cable and General Radio connector
b. earthing lead
c. BNC to measuring pin adapter
d. five earthing terminals
e. box for storing items *a* to *d* together with a PM 9344 T-piece.

This passive measuring probe is intended for use in sampling oscilloscopes with an input impedance of 50 Ω.

Provisional electrical data

1. attenuation	10×
2. input resistance	500 Ω ± 1.5 %
3. input capacitance (from 0 to 10 MHz)	0.7 pF
4. input impedance (at 1 GHz)	≈ 300 Ω
5. rise time	≤ 100 psec
6. equivalent bandwidth	0 – 3.5 GHz (—3 dB)
7. max. input voltage	d.c: 16 V
	a.c: 45 V_{p-p} up to 800 MHz
8. max. power to be applied	0.25 W

D. PM 9343 (See Fig. 11)

1 : 100 attenuator, consisting of *a* to *e* as in C above. This passive measuring probe is intended for use in sampling oscilloscopes with an input impedance of 50 Ω.

Provisional electrical data

1. attention	100 ×
2. input resistance	5000 Ω ± 1.5%
3. input-capacitance (from 0 to 10 MHz)	0.6 pF
4. input impedance (at 1 GHz)	≈ 1500 Ω
5. rise time	≤ 200 psec.
6. equivalent bandwidth	0–1.7 GHz (–3dB)
7. max. input voltage	d.c. : 50 V
	a.c. : 140 V_{p-p} up to 500 MHz
8. max. power to be applied	0.25 W

E. PM 9344 (See Fig. 14)

T-piece with General Radio connectors for making measurements with a PM 9341 or PM 9342 attenuator probe in 50 Ω coaxial cables.

Provisional electrical data

1. frequency range	0 – 2 GHz
2. impedance	50 Ω
3. pulse reflection (see fig. 1)	without measuring probe: less than 5%
	with PM 9342 measuring probe (10×):
	A = 10%, B = 5%
	with PM 9343 measuring probe (100×):
	A = 2%, B = 5%

F. EXTENSION CABLE, see Fig. 2

When this cable is used, measurements may be made on the plug-in units while they are actually in use. The cable is also used in checking and adjusting the plug-in units.

* Code number: 4822 159 00558

26370008 £120

G. EXTENSION PLUG, see Fig. 3

The extension plug is used in checking and adjusting the vertical amplifier of the sampling system.

* Code number: 4822 159 00559

* *These components may be ordered from the Central Service Department. The extension cable and plug are the same as those used in the PM* 3330 *plug-in oscilloscope.*

Controls, input and output connectors

IV

A. SAMPLING AMPLIFIER PM 3419 A

Control or connector	*Location*	*Designation*	*Purpose*
S1	front panel	"TRIGG A–B"	Selection of trigger signal to the Sampling Time Base Unit from either the A-channel or the B-channel of the Dual Trace Amplifier PM 3419 A.
S2	front panel	"Y_A mV/cm"	Attenuator for the vertical signal in the A-channel.
S3	front panel	"Y_B mV/cm"	Attenuation of the vertical signal in the B-channel
S4	front panel	"NORMAL-SMOOTHED"	Smoothing of the random noise on both A- and B-channels.
S5	front panel	"Added A+B, A—B, A, B, alternate A and B, alternate A and –B, A VERT. B HOR."	Mode switch for the selection of A- and/or B-channels in different combinations. It is also possible to use the A-channel for vertical deflection and the B-channel for horizontal deflection.
RV1	front panel	"Y_A SHIFT"	Coarse adjustment of the vertical position of the A trace.
RV2	front panel	"Y_A SHIFT"	Fine adjustment of the vertical position of the A trace.
RV3	front panel	"Y_B SHIFT"	Coarse adjustment of the vertical position of the B trace.
RV4	front panel	"Y_B SHIFT"	Fine adjustment of the vertical position of the B trace.
RV5	front panel	"Y_A mV/cm CAL."	Fine adjustment of the attenuation of the Y_A signal.
RV6	front panel	"Y_B mV/cm CAL."	Fine adjustment of the attenuation of the Y_B signal.
P1	front panel	"Y_A 50 Ω max. 2 V"	Input connector of the A-channel.
P2	front panel	"Y_B 50 Ω max. 2 V"	Input connector of the B-channel
P3	front panel	"PROBE POWER"	Power output connector intended for a measuring probe of the A-channel.
P4	front panel	"PROBE POWER"	Power output connector intended for a measuring probe of the B-channel.
P5	front panel	"Y_A OUT"	Output connector for the signal from the A-channel.
P6	front panel	"Y_B OUT"	Output connector for the signal from the B-channel.
P11	rear panel	—	Internal connector between the Sampling Dual Trace Amplifier and the Basic Oscilloscope.

A mechanical push-button under the switch S4 ("NORMAL-SMOOTHED") is to be pushed to release the unit from the basic oscilloscope.

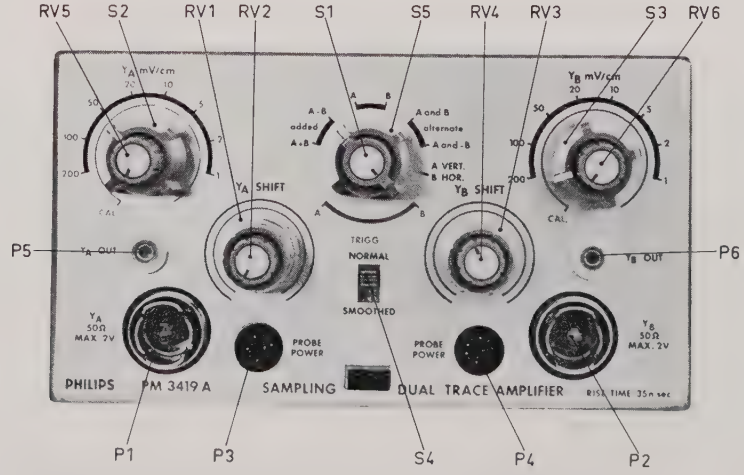


Fig. 4. Front view PM 3419A

B. SAMPLING TIME BASE UNIT PM 3419 B

Control or connector	*Location*	*Designation*	*Purpose*
S1	front panel	"TRIGG."	Selection of internal or external triggering (pos. or neg.) or free running.
S2	front panel	"TRIGG.-SYNC."	Selection of triggering or synchronizing mode.
S3	front panel	"TIME/cm"	Selection of the sweep speed between 1 ns and 10 µs.
S4	front panel	"TIME SCALE MAGN."	To increase the sweep speed up to 100 times.
S5	front panel	"X DEFL."	Selection of the type of deflection. – Number of samples/cm. – Manual deflection. – Deflection from an external source. – Repeated sweeps where the sweep speed of the single deflection can be adjusted. – Single deflection (with the aid of the push-button S6).
S6	front panel	"START"	Push-button for starting the single sweep when S5 is in position "Single". The sweep starts when the push-button is depressed, but if the push-button is kept depressed the sweep does not return, which can be used in connection with X-Y recorders.
RV1, RV2	front panel	"TRIGG. SENSITIVITY"	Sensitivity control of the triggering or synchronizing, with fine adjustment.
RV3	front panel	"X SHIFT"	Coarse adjustment of the X position of the signal.
RV4	front panel	"X SHIFT"	Fine adjustment of the X position of the signal.
RV6	front panel	"TIME SCALE MAGN."	Fine adjustment of the magnification.

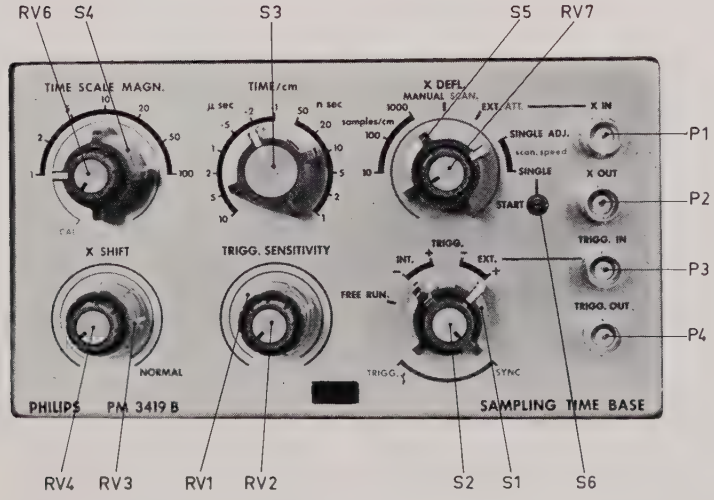


Fig. 5. Front view PM 3419B

Control or connector	*Location*	*Designation*	*Purpose*
RV7	front panel	"SCAN." "ATT." "scan speed"	Depending on the position of the X deflection switch S5. S5 in pos. 10, 100 and 1000 samples/cm: RV7 no function. S5 in pos. "MANUAL": Manual scanning. The horizontal position of the spot is directly governed by the potentiometer. S5 in pos. "EXT.": Attenuation of applied external deflection voltage. S5 in pos. "SINGLE ADJ" and "SINGLE": Control of horizontal speed of the spot between 1 and 60 sec. (without affecting the calibrated time/cm).
P1	front panel	"X IN"	Input connector for external deflection voltage, when S5 is set in position "EXT.".
P2	front panel	"X OUT"	Output connector for the X deflection voltage from the time base unit.
P3	front panel	"TRIGG. IN."	Input connector for trigger signals when external triggering is used.
P4	front panel	"TRIGG. OUT"	Output connector of trigger signals for external use.
P12	rear panel	—	Internal connector between the Sampling Time Base Unit and the Basic Oscilloscope.

A mechanical push-button under the control RV1 ("SENSITIVITY") is to be pushed to release the unit from the basic oscilloscope.

Operation

A. PRELIMINARY ADJUSTMENT

1. Displaying signals

Apply the signal(s) to be tested to the input socket(s) YA and/or YB and set the controls of the units as follows.

Amplifier unit:

MODE S5	"A" or "B" resp.
TRIGG. S1	"A" or "B" resp.
Y-SHIFT	mid-position
NORMAL-SMOOTHED	NORMAL

Time base unit:

TIME SCALE MAGN.	1
X-DEFL.	100 samples/cm
X-SHIFT	NORMAL
TRIGG. SENSITIVITY	anti-clockwise
TRIGG. S1	FREE RUN.
TRIGG.-SYNC.	TRIGG.

When a number of widely spread-out dots as well as a line are visible on the screen, there is an input signal capable of effecting triggering. Proceed as follows:
– Set TRIGG. to position INT. + or —
– Turn TRIGG. SENSITIVITY to the right until a stable picture is obtained.

Note: The input signal must be at least 45 mV_{p-p}. If it is weaker than this, an external trigger signal of at least 5 mV_{p-p} must be applied to socket P3, TRIGG. IN. In such an instance, switch TRIGG. is set to position EXT. + or —.

– Adjust the desired image height using switches YA mV/cm and/or YB mV/cm.
– Set the required time coefficient using TIME/cm.
– Set the image in the centre of the screen with the aid of the Y SHIFT and X SHIFT controls.

2. Measuring accessories

For the technical data on the accessories available, see chapter III.

a. PM 9340 cathode follower probe

– Attach an adjusted ×10 attenuator from the PM 9341 set of slip-on accessories to the measuring head.
– Connect the measuring probe to the correctly set sampling system.
– Apply a square-wave voltage of 1 V_{p-p} with a frequency of 1 kHz to the measuring probe.
– Check to see whether the attenuation is, in fact, 10×. If necessary, adjust by means of the potentiometer fitted to the printed circuit board in the measuring probe.
– The measuring probe can be taken apart once the securing screw at the side has been unscrewed.

b. PM 9341 set of slip-on accessories

– Attach the appropriate attenuator to a correctly set PM 9340 cathode follower measuring probe.
– Connect the measuring probe to the sampling system.
– Apply a square-wave voltage with a frequency of 100 kHz to the measuring probe, as given in the table below.
– Adjust the trimmer at the side of the slip-on attenuator until a satisfactory square-wave shape is obtained.

Attenuator	*Voltage to be applied*	*Oscilloscope setting*
× 10	1 V_{p-p}	20 mV/cm
× 20	2 V_{p-p}	20 mV/cm
× 50	5 V_{p-p}	20 mV/cm
× 100	10 V_{p-p}	20 mV/cm
× 200	20 V_{p-p}	20 mV/cm
× 500	20 V_{p-p}	10 mV/cm
×1000	20 V_{p-p}	5 mV/cm

c. PM 9342 and PM 9343 1 : 10 and 1 : 100 attenuator probe

– Connect the measuring probe to the sampling system.
– Set the sensitivity of the oscilloscope to 20 mV/cm.
– Apply a square-wave voltage of 0.8 V_{p-p}, 100 kHz (for the PM 9342) or of 8 V_{p-p}, 100 kHz (for the PM 9343) to the measuring probe.
– Adjust until a satisfactory square-wave shape is obtained.
To this end, remove the grommet from the measuring probe and, after releasing the retaining screw, rotate the forward section of the probe in relation to the rear section.

B. X SHIFT

The X SHIFT adjustment is in principle a delay control with a coarse and a fine adjustment. The sweep always starts at the left-hand side of the screen (this can only be adjusted by an internal preset potentiometer).
When both controls are in the fully clockwise position the delay is minimum. In this position it should always be possible to see the triggering edge, provided that the time scale switch is in position 2 ns/cm, unmagnified. The triggering edge moves to the left when the X SHIFT control is turned to the left.
If the time scale is to be magnified, first place the significant part of the display in the middle of the screen. The magnifier operates in such a manner that the part of the display which is in the middle of the screen stays there during magnification.

C. TIME COEFFICIENT

The time coefficient is selected with the TIME/cm switch, while the time scale can be enlarged up to 100× by means of the TIME SCALE MAGN.
The time coefficient is always equal to the quotient of the adjustment of the TIME/cm switch and the setting of the TIME SCALE MAGNIFIER.
The time coefficient can be continuously varied by means of the fine adjustment knob of the TIME SCALE MAGNIFIER. The time coefficients are calibrated only in the CAL. position of this fine adjustment knob.
It should be noted that the apparent speed of the beam across the screen of the c.r.t. is not equal to the actual time coefficient in sec/cm.

Note: Before switching over to magnification using the TIME SCALE MAGN. switch, first adjust with the TIME/cm switch to as short a time as possible and then bring the part to be magnified to the centre of the screen with the aid of the X-SHIFT control.

D. MODE S5 (AMPLIFIER)

Any one of seven methods of operation may be chosen using the mode selector S5.

"A"	Only the input signal of channel A is displayed
"B"	Only the input signal of channel B is displayed
"A and B" alternate	Both input signals are given at the same time
"A and —B" alternate	Both input signals are given at the same time, the polarity of signal B being reversed.
"A + B" added	The signals from A and B are added together.
"A — B" added	The signals from channels A and B are added together, the polarity of signal B being reversed.
"A vert., B hor."	The input signal from channel B is used for horizontal deflection. Switch "YB mV/cm" now determines the horizontal sensitivity while the image can be shifted horizontally by knob YB-SHIFT.

E. TRIGGERING

A choice may be made between internal and external triggering by means of the trigger mode selector S1 (time base generator). With internal triggering, the trigger signal is derived from the input signal to be tested, which must, in this case, be at least 45 mV_{p-p}. With external triggering a trigger signal of at least 5 mV_{p-p} is applied to socket P3, TRIGG. IN. Both the positive and negative going flanks of the input or trigger signal may be used for triggering.
With internal triggering, the TRIGG switch (S1, amplifier unit) is used to select a trigger signal originating from channel A or B.

F. TRIGG. SENSITIVITY

The trigger sensitivity control has a double knob. In most cases the adjustment should be possible by means of the larger knob.
The smaller knob is effective only in the trigger mode and only when the input signal has the same frequency or is a multiple of the sampling frequency (approx. 100 kHz).
In such cases it is possible to change the sampling frequency slightly by the smaller knob to obtain a stable display.

G. HORIZONTAL DEFLECTION, "X DEFL."

1. 10 - 100 - 1000 samples/cm

The 100 samples/cm method of operation will be the one generally used. The distortion, which in some cases occurs in the reproduction of fast voltage steps is usually sufficiently slight with this method, while generally a sufficiently high writing speed is obtained. The cause of the distortion that occurs, lies in the fact that in some cases (highest sensitivities; smoothed mode) a number of samples is required in the sampling technique before the unit step movement at the input is followed, with a given accuracy, by the vertical displacement of the electron beam.

Example:

Let us assume that five samples are needed to display the unit step on the screen with an amplitude accuracy of 1% (see fig. 6).

At 10 samples/cm, the unit step would be inscribed within 5/10 cm, or 5 mm horizontal shift.
With 100 samples/cm, the horizontal shift in this case

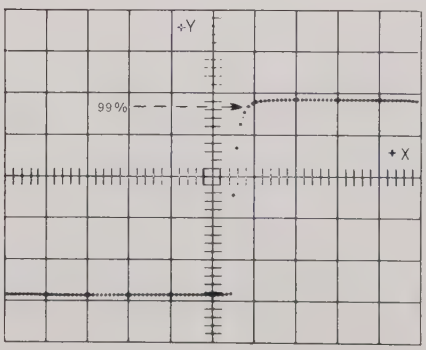


Fig. 6. Screen display

would be about ten times as small, and with 1000 samples/cm even about a hundred times as small. The latter method is, however, used, only if the "smoothed" mode is applied. See also section H, "NORMAL SMOOTHED".

At low repetition frequencies of the input signal, the electron beam will move over the screen relatively slowly, so that the eye no longer sees a continuous image. In such a case, it may be helpful to use the 10 samples/cm method.

This however may increase the degree of rounding-off of steep flanks.

2. Manual scan

In this position of the X-DEFL. switch, the horizontal deflection of the electron beam is dependent on the position of potentiometer RV7. This method is used in recording oscillograms on recorders and when making accurate amplitude measurements (detail measurements).

3. EXT.

In this position of the X-DEFL. switch, the electron beam is deflected horizontally by means of an external voltage applied to socket P1, X-IN. This voltage can, for instance, be derived from the horizontal deflection system of an X–Y recorder.

4. SINGLE ADJ. and SINGLE

The single shot method is used in photographing screen images and in recording oscillograms on recorders. In the "SINGLE ADJ." position the image is repeatedly inscribed. The speed of inscription can be adjusted by means of potentiometer RV7.

In the SINGLE position, the image is inscribed once at the inscription speed set by RV7 as soon as the START button is pressed. A special feature here is that the electron beam does not fly back if the START button is held down. In some cases this may be used to prevent damage to the stylus of a recorder caused by the fast flyback.

It should be noted that the above single shot mode differs from the single shot mode of non-sampling systems because of the repetitive input signal to be applied.

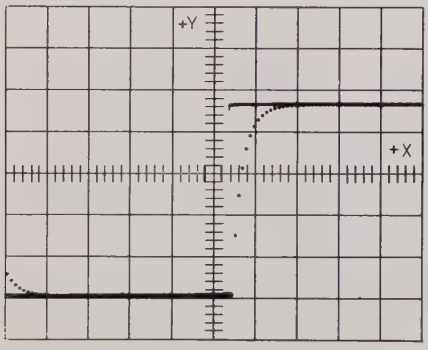


Fig. 7. Effect of sampling density on step response when smoothing is used

H. NORMAL SMOOTHED

A fairly broad band of points making reading of the oscillogram difficult may be produced on the screen as a result of inequality between subsequent periods of a periodic signal and of amplitude variations in quick succession, e.g. noise, particularly when measurements are made at high sensitivity. The noise band can be greatly reduced by using the "SMOOTHED" method. Here the rough average of a quickly varying inpu voltage (noise voltage) is reproduced. In this method, therefore, the unit step, as mentioned in section G.1, will require a much larger number of samples in order to obtain a given amplitude accurately on the screen. When the "smoothed" method is used, therefore, it is desirable to switch to 1000 samples/cm to reduce the rounding-off of fast steps.

Fig. 7 shows a display with a sampling density of 10 and 1000 samples/cm when smoothing is used.

The number of samples required to obtain a given amplitude accuracy depends not only on the selection of NORMAL or SMOOTHED, but also on the position of the vertical attenuator. The circuit is arranged in such a way that some smoothing automatically occurs in positions 2 and 1 mV/cm.

J. INPUT CIRCUIT

The input impedance of the vertical deflection system of the sampling unit is 50 Ω and the maximum input voltage is 2 V_{p-p}.

If the input voltage is higher than 2 V_{p-p} any commercially available coaxial attenuators with a characteristic impedance of 50 Ω may be used.

If a higher input impedance is required, an attenuator measuring probe (PHILIPS PM 9342 or PM 9343) or a cathode follower measuring probe (PHILIPS PM 9340) can be used. The latter may, if necessary, be combined with a slip-on coupling capacitor and/or one of the available slip-on attenuators (PHILIPS PM 9341). Power for the cathode follower measuring probes is supplied from socket P3 or P4, PROBE POWER.

The cathode follower measuring probe allows an input impedance of 10 MΩ to be obtained at a low input capacitance (about 1.3 to 3.6 pF).

K. RECORDER OUTPUT

A recorder for recording oscillograms may be connected to output sockets YA OUT and YB OUT. The output impedance of the recorder outputs is 1 kΩ. The sensitivity is 0.5 V per cm deflection on the screen.

If a compensation recorder is used in the MANUAL SCAN and SINGLE or SINGLE ADJ. methods, carrying out or setting slow scanning allows of a high input resistance of the compensation recorder to be maintained.

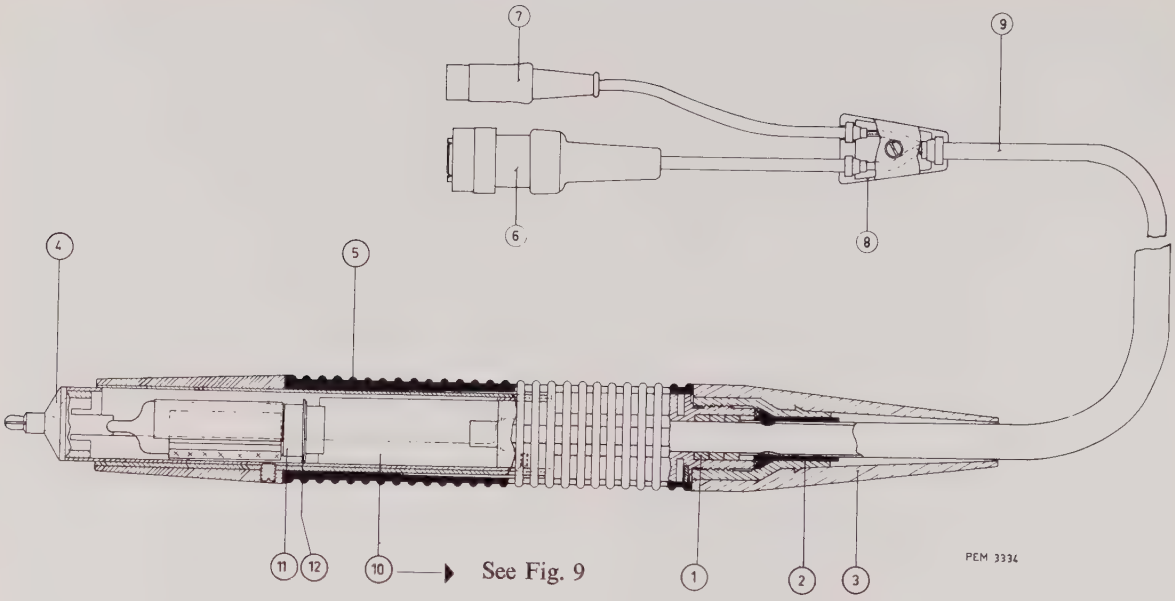


Fig. 8. Cathode follower probe PM9340

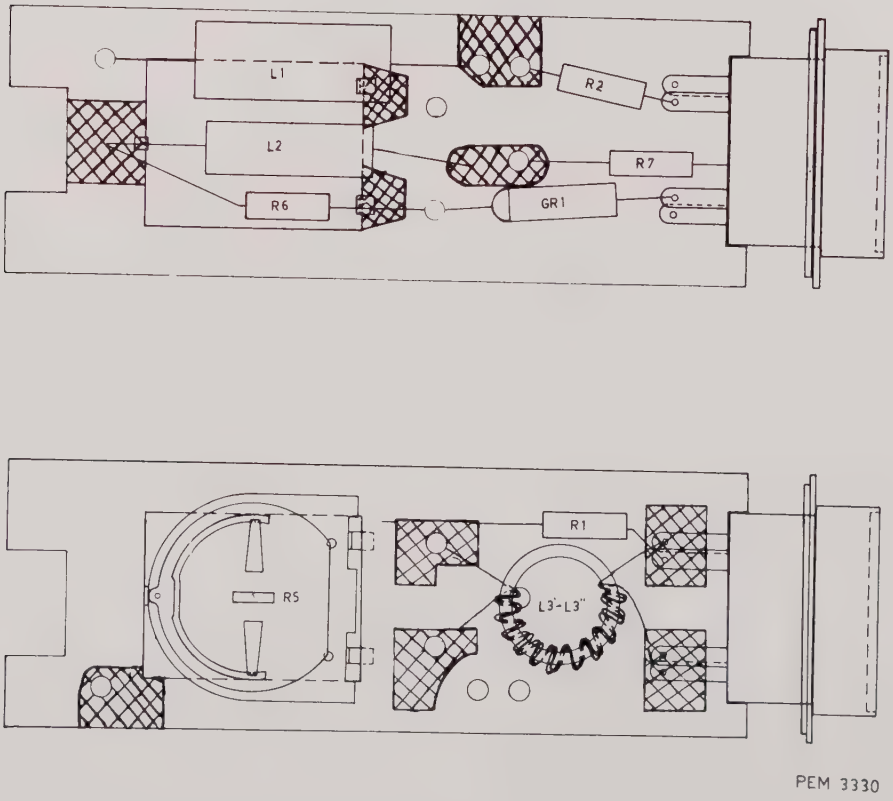


Fig. 9. Printplate unit 1 of cathode follower probe PM 9340

Parts lists of accessories

VI

A. LIST OF PARTS PM 9340

Item	*Number*	*Fig.*	*Code number*	*Description*
1	3	8	4822 526 10047	Ferroxcube ring
2	1	8	4822 532 60325	Clamping piece
3	1	8	4822 325 50064	Grommet
4	1	8	4822 447 60032	Contact piece
5	1	8	4822 447 60033	Insulator
6	1	8	4822 264 10031	Connector (General Radio: 874–CL58A)
7	1	8	4822 264 40022 (978/4×270)	Plug (Preh: 6081)
8	2	8	4822 447 60031	Cap
9	1.75 m	8		Cable
10	1	8,9	4822 216 90073	Unit 1
11	1	8	4822 255 70115	Valve support
12	1	8	4822 532 10329	Fixing ring
L1		9	4822 157 50317	Coil 22 µH
L2		9	4822 157 50318	Coil 1 µH
L3		9	4822 158 10131	Coil
C1		–	4822 122 70068	Ceramic capacitor 3300 pF, 500V
R1		9	4822 111 30238	Carbon resistor 82 Ω, 0.1 W, 5%
R2		9	4822 111 30238	Carbon resistor 82 Ω, 0.1 W, 5%
R3		–	4822 111 30239	Carbon resistor 43 Ω, 0.1 W, 5%
R4		–	4822 111 20256	Carbon resistor 3 MΩ, 0.25 W, 2%
R5		9	4822 100 10059	Potentiometer 200 Ω
R6		9	4822 111 30241	Carbon resistor 33 Ω, 0.1 W, 5%
R7		9	4822 111 30242	Carbon resistor; 620 Ω, 0.1 W, 5%
GR1		9	BAY 38	Diode
B1		8	EC 1000	Triode

B. LIST OF PARTS PM 9341

Item	*Number*	*Fig.*	*Code number*	*Description*
1	1	10	4822 265 20049	Earthing clip
2	2	10	4822 492 60937	Clamping spring
3	1	10	4822 535 90356	Pin
4	1	10	4822 447 60029	Coupling capacitor
5	1	10	4822 210 70033	×10 attenuator
6	1	10	4822 210 70034	×20 attenuator
7	1	10	4822 210 70035	×50 attenuator
8	1	10	4822 210 70036	×100 attenuator
9	1	10	4822 210 70037	×200 attenuator
10	1	10	4822 210 70038	×500 attenuator
11	1	10	4822 210 70039	×1000 attenuator

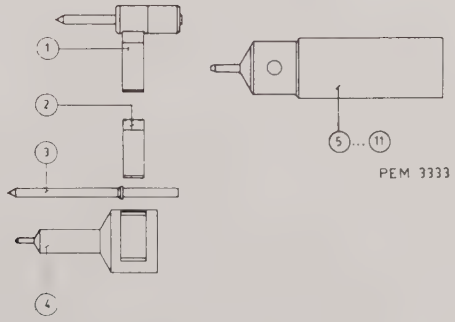


Fig. 10. Slip-on accessories PM 9341

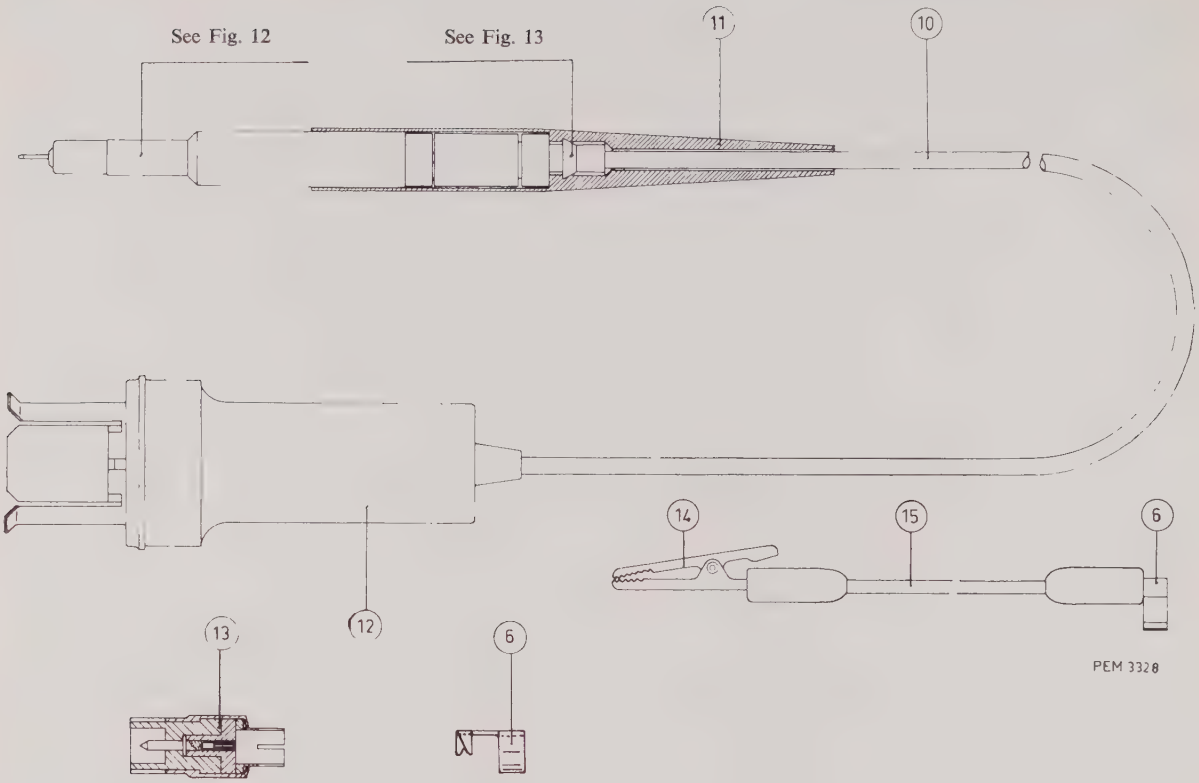


Fig. 11. Attenuator probe PM9342-PM9343

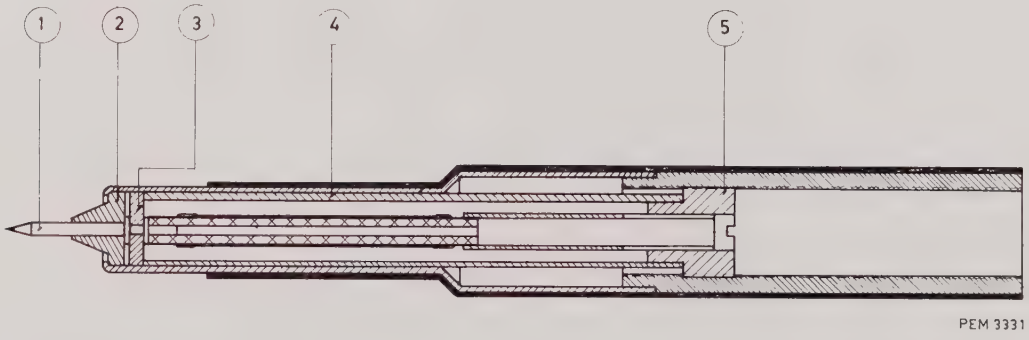


Fig. 12. Front piece PM9342-PM9343

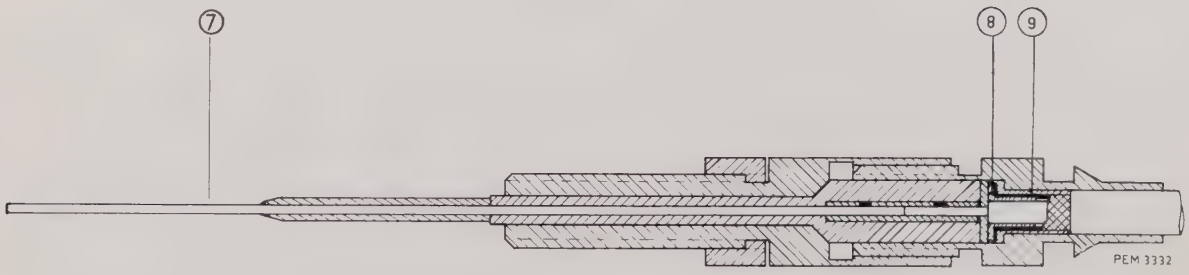


Fig. 13. Rotor PM 9342-PM 9343

C. LIST OF PARTS PM 9342 AND PM 9343

Item	*Number per instrument*	*Fig.*	*Code number*	*Description*
1	1	12	4822 111 90027	Resistor PM 9342
1	1	12	4822 111 90028	Resistor PM 9343
2	1	12	4822 532 50522	Insulation
3	1	12	4822 466 90329	Plate
4	1	12	4822 532 70093	Bushing
5	1	12	4822 502 10656	Screw
6 (2×)	6	11	4822 492 60938	Earthing clip
7	1	13	4822 535 90357	Pin
8	1	13	4822 535 20315	Bush
9	1	13	4822 532 20314	Bush
10	0.5 m	11	4822 320 10037	Cable
11	1	11	4822 325 50062	Grommet PM 9342
11	1	11	4822 325 50063	Grommet PM 9343
12	1	11	4822 264 10029	Connector (General Radio: 874-C174A)
13	1	11	4822 263 50022	Adaptor
14	1	11	4822 290 40044 (978/9)	Crocodile clip
15	10 cm	11	4822 322 10001	Earthing wire

D. LIST OF PARTS PM 9344

Item	*Number*	*Fig.*	*Code number*	*Description*
1	2	14	4822 267 10027	Connector (General Radio: 874-BL)
2	1	14	4822 535 80313	Pin
3	2	14	4822 532 10328	Contact flange
4	2	14	4822 492 60936	Spring
5	1	14	4822 535 80322	Pin

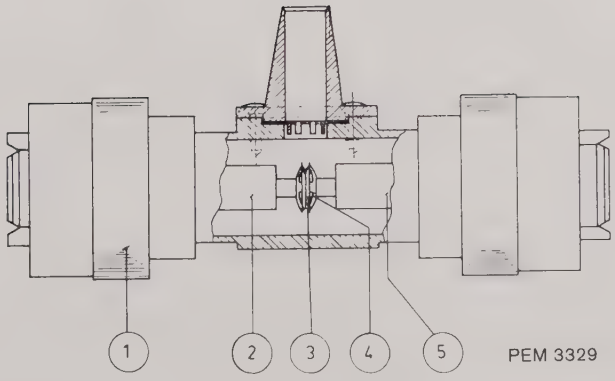
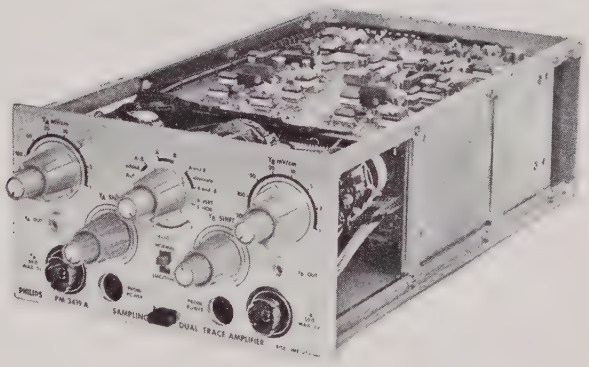


Fig. 14. T-piece PM 9344

PHILIPS



Service manual

PM 3419 A — Dual trace sampling amplifier

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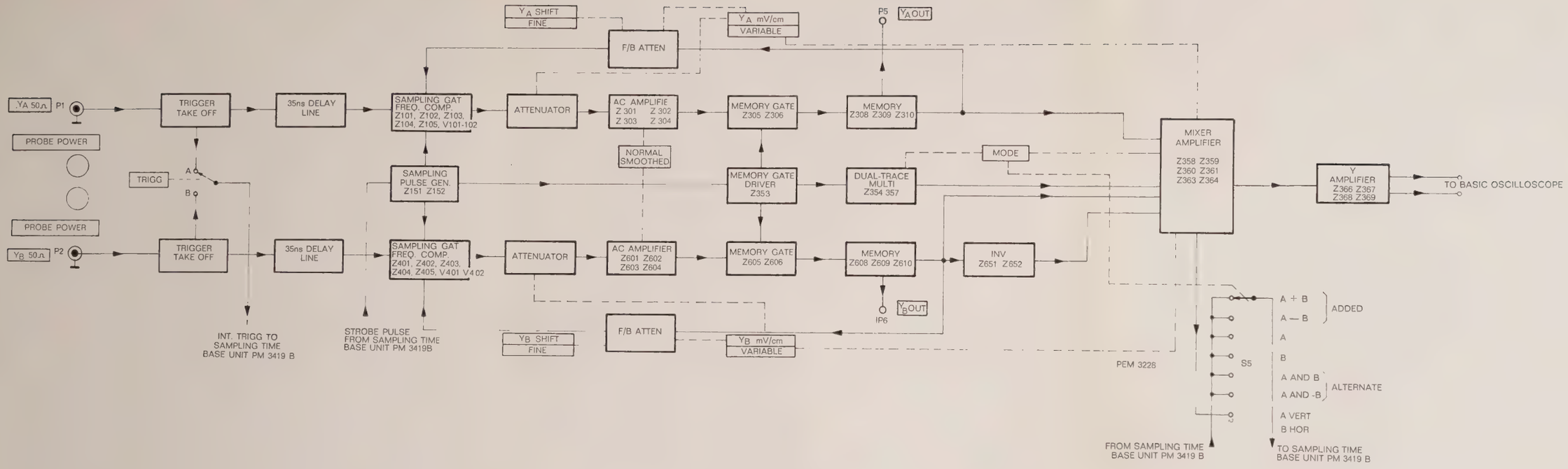


Fig. 1. Block diagram

Description of the block diagram 1

The Dual Trace Sampling Amplifier consists of two similar channels, A and B, as well as certain circuits which are used by both channels. These common circuits are the sampling pulse generator, memory gate driver, dual trace multivibrator, mixer amplifier and the Y amplifier. As the channels are exactly similar, only one of them will be described.

The signal is applied to a 50 Ω connector P1 with a trigger take-off transformer fitted directly to it. A small part of the signal is taken out and fed to the X deflection unit PM 3419 B, where it starts the timing circuits. After a short interval the time base unit sends back a strobe pulse to the sampling pulse generator. After amplification and shaping, this pulse is used to open the sampling gate. The minimum time needed for the whole triggering process must be compensated for if the triggering part of the waveform is also to be observed. The compensation is done by the 35 ns delay line between the trigger take-off transformer and the sampling gate.

When the sampling gate is open, a capacitor is charged to a voltage, proportional to the difference between the signal level at the moment of sampling and the voltage established by the preceding sampling. The ratio between the voltage across the capacitor and the signal voltage is called sampling efficiency and is approx. 20%. After amplification, the voltage is fed to a memory via a memory gate, which is kept open for approx. 0.5 µs after each sampling. The memory stores the voltage until the next sampling. The output of the memory is fed back to the sampling capacitor at the input of the amplifier. The amplification is so chosen that the input capacitor is allowed to charge to the full signal voltage. This means that the feedback compensates for the inefficiency of the sampling gate. When the compensation is exactly right the loop gain is said to be 1.

The amount of feedback voltage can be changed by means of an attenuator, which therefore changes the sensitivity. In order to keep the loop gain constant this attenuator is coupled with a corresponding attenuator between the sampling gate and the memory.

The outputs of the memories of both channels are connected via the mode switch to the mixer amplifier. Depending on the position of the mode switch, a signal is applied to the mixer amplifier either from channel A or channel B – or some kind of combination. This function is controlled by a bi-stable multivibrator.

After the mixer amplifier the signal is further amplified in the Y amplifier and is then sent via a connector to the vertical deflection amplifier in the basic oscilloscope.

By means of the mode switch it is also possible to take out the Y_B signal, and use it for X deflection in the basic oscilloscope.

The fundamental principles of sampling have been fully described in books and periodicals. Some familiarity with this is assumed. The following references serve as a guide to basic reading.

1. Millman and Taub

Pulse, digital and switching waveforms
Chapter: Sampling Gates Page 664-66

2. Electronic Instrument Digest, Sept.-Oct. 1965.

Description of circuit

The description of the block diagram explains that the Dual Trace Sampling Amplifier is built up in two channels similar to each other from the input connector up to the memory circuits. Therefore this description will follow the signal in only one of these channels and further through the mixer amplifier and the Y amplifier.

Trigger take-off

The signal to be sampled is applied to the 50 Ω input connector P1 (and/or P2). The signal passes through the primary winding of the trigger take-off transformer T1. From the secondary winding a part of the signal is fed to the Sampling Time Base Unit, PM 3419 B, to trigger this unit.
Depending on the position of the switch S1, the trigger signals are supplied from either transformer T1 or T2 to the PM 3419 B Sampling Time Base Unit.

Sampling pulse generator

From the Sampling Time Base Unit a trigger pulse is fed to the base of the avalanche transistor Z151 in PM 3419 A (see further the description of PM 3419 B). The trigger pulse – strobe pulse – is further amplified and shaped by the transistor Z151 and a negative step appears at the collector. The avalanche voltage is adjusted by means of the potentiometer RV151 ("AVALANCHE VOLTS"). The negative going step is fed to the symmetrical transformer T151. A bias-current flows in the forward direction through the diode Z152. The current is adjustable by means of the potentiometer RV152 ("RISE TIME"). Therefore the negative step from the transistor Z151 has to overcome the bias-current and it is only after a certain time that a positive step with a rise time of 0.2 ns will occur at the cathode side of the diode Z152. The same step – but with opposite polarity – is at the same moment present at the solder-point of the secondary winding of the transformer T151 and the capacitor C157.
Both these pulses travel along a short-circuited transmission-line formed by a twisted pair. The pulses are cancelled out when they meet at the earthing point. Consequently the pulse width is determined by the length of the twisted pair. The lines between the transformers T151 and T101 (or T151 and T401) are also twisted pairs, and consequently the pulses appearing at the solder-points of C103 and T101 or C104 and T101 are similar to each other both in amplitude and pulse width, but of opposite polarity. It is essential that the pulses are as equal as possible in order to ensure correct functioning. The transmission-line transformer T101 is terminated by the resistors R108 and R109.

Sampling gate

The pulses now go through the capacitors C103 and C104. They cannot go through the filter consisting of the ferrite beads (inductances) L105, L106, L107, L108 and the capacitor C105.
From the capacitors C103 and C104, the pulses go to the sampling diodes Z101 and Z102. Z101 has a bias of about +2 V and Z102 of about —2 V.
Consequently the pulses emanating from C103 and C104 have to reach these values before current can flow through Z101 and Z102. The current through Z101 and Z102 also depends on the input signal from connector P1. From P1 the signal goes through the trigger take-off transformer T1, the delay line DL1 and passes via the network consisting of C101, R101, L101 and R102 to the terminating resistors R103 and R104. The delay line DL1 is inserted in order to delay the signal until the Sampling Time Base Unit has started. The network compensates for signal loss due to the delay line.

The signal appears at the point between the diodes Z101 and Z102. Current flows through the diodes during the sampling interval (about 0.35 ns) and, if the input signal differs from that at the previous sampling, the capacitors C103 and C104 will be charged. This charge is fed to the grid of the triode V101.
The biasing of the diodes Z101 and Z102 depends on the position of the potentiometer RV102 ("RISE TIME") because the resistors R116 and R119 are connected to the voltage divider consisting of the resistors R117, R118, RV102 and R115.
Another voltage divider is connected across R118 and RV102. By means of the potentiometer RV101 ("BRIDGE BALANCE") it is possible to adjust for differences between the two diodes Z101 and Z102.
A similar network is formed by capacitors CV101, C102 and CV102 to compensate for the capacitance of the diodes Z101 and Z102. A small part of the signal will pass through the capacitances of the sampling diodes and go directly to the grid of the triode V101. A similar part of the signal will, via the compensating network, pass to the grid of the triode V102. The tubes V101 and V102 and the transistors Z103, Z104 and Z105 form a differential amplifier.
From the memory circuit a feedback voltage is applied to diodes Z101 and Z102 via resistor R112 and the

bias network. Only if the input signal differs from this feedback voltage will there be an output signal from the differential amplifier.

AC amplifier

The output signal from the collector of the transistor Z105 in the differential amplifier is fed to the base of the transistor Z301 via an attenuator. Z301 is the input of the AC amplifier, which consists of two pairs of feedback transistors, Z301 and Z302 resp. Z303 and Z304. The amplification of the AC amplifier is adjusted by means of the potentiometer RV301 ("A LOOP GAIN").

Memory gate driver and memory gate

Transformer T351 and transistor Z353 form a blocking oscillator. From the collector of the transistor Z151 in the sampling pulse generator circuit a trigger pulse arrives at this blocking oscillator and starts it. From the winding a 1/a2 gate pulses are fed to the memory gate circuit Z305 and Z306, which is kept open for approx. 0.5 μs after each sampling.

Memory

When the memory gate is open the signal from the AC amplifier can charge the memory capacitor C311. Z308 is a field effect transistor to provide a low leakage input. Together with Z309 and Z310, it forms an amplifier, and the memory capacitor is connected as a feedback element from output to input. The change in output voltage of the memory is therefore proportional to the signal from the AC amplifier. The smoothing, which can be introduced by switch S4, is produced by increasing the memory capacitor. By doing so the loop gain is decreased to approx. 1/3. The random noise is decreased in the same proportion. The consequence is, however, that the charge on the sampling capacitor (immediately after the sampling gate) is not fully compensated for the inefficiency of the sampling gate. It takes a few more samples to build up the correct charge and this shows up in rounded waveforms, this rounding can be misinterpreted as a slow rise time. It is therefore important to have a high sampling density, when smoothing is used.

Y shift (DC-offset)

The output from the memory is fed back to the sampling diodes via the attenuator S2, resistor R112 and the diode biasing network. Via the potentiometers RV1 and RV2 ("Y_A SHIFT") a DC voltage is added to the feedback voltage. By means of these potentiometers the trace on the CRT can be moved vertically. That means, that it is possible to set the switch S2 ("mV/cm") in position e.g. 1 mV/cm and move the trace by means of RV1 or RV2, and study any part of a large input signal in greater detail.

B-channel inverter

As mentioned earlier, the A- and B-channels are similar to each other up to the memory circuit. However, to the B-channel is added an inverter, consisting of the transistors Z651 and Z652. The amplification in this inverter is —1. The balance of the inverter is adjusted by means of the potentiometer RV651 ("—B BAL").

Dual trace multivibrator and mixer amplifier. Display modes.

The "dual trace multivibrator" consists of a bistable multivibrator Z354 and Z357 and the mixer amplifier consists of Z361 and Z364. The currents through Z361 and Z364 are settled by the position of the bistable multivibrator which is directed by trigger pulses from the blocking oscillator Z353 and the position of the mode switch S5.

When Z354 is conducting its collector is at +15 volts. At the same time Z357 is non-conducting and its collector is at —5 volts. Via the diode Z358 the collector of the transistor Z361 is held at +15 volts while the diode Z359 is reverse biased. The emitter current of Z364 is thus fed to the Y amplifier. When the bistable multivibrator is set in the other position the emitter current of Z361 is fed to the Y amplifier.

When the switch S5 is in the position shown ("A+B added"), the signal path from the A-channel is from the memory capacitor C311 through the potentiometers RV5 ("Y_A VERNIER") and RV7 ("A CAL") and the resistor R5 to the emitter of Z364. The signal path from the B-channel is from the memory capacitor C611 through the potentiometers RV6 ("Y_B VERNIER") and RV8 ("B CAL") and the resistor R6 to the emitter of Z364.

The signals from the A- and B-channels are thus added on the emitter of Z364. In this position of S5 the base of Z354 is connected to earth, which means that the multivibrator is in such a position that the emitter current of Z364 is fed to the Y amplifier.

In the second position ("A—B added") of S5 the signal path from the A-channel is the same as earlier, but the signal from the B-channel is taken out after the inverter from the diode Z653 through RV6, RV8 and R6 to the emitter of Z364.

The multivibrator is in the same position as earlier. That means that the signal to the Y-amplifier is the signal from the A-channel minus the signal from the B-channel. In the third position ("A") of S5, only the signal from the A-channel is fed to the Y amplifier.

In the fourth position ("B") of S5 the multivibrator is switched to the other position and only the signal from the B-channel is fed to the Y-amplifier. In the fifth ("A and B alternate") and sixth positions ("A and —B alternate") of S5 the state of the multivibrator varies with the trigger pulses from the blocking oscillator.
Signals from either the A-channel or the B-channel are therefore alternately fed to the Y amplifier. In position five the signal from the B-channel is taken before and in position six after the inverter. Finally, in position seven ("A VERT. B HOR.") of S5 the signal from the A-channel is fed to the Y amplifier and the signal from the B-channel is fed to the Sampling Time Base Unit and further to the horizontal deflection amplifier in the basic oscilloscope.
The balance of the A-channel is adjusted with RV353 ("A BAL") and the balance of the B-channel is adjusted with RV352 ("B BAL").

Y amplifier

The Y amplifier Z366, Z367, Z368 and Z369 is a differential amplifier. The amplification can be adjusted by means of the potentiometer RV354 ("Y GAIN"). From the emitters of Z367 and Z368 the output signals are fed to the vertical deflection amplifier in the basic oscilloscope.

Adjusting elements and their functions

Adjustment	*Adjusting elements*	*Instrument required*	*Specifications*	*Proposed model*	*Chapter IV section*
Avalanche volts	RV 151	Oscilloscope	DC to 10MHz bandpass. Sensitivity 2 mV/div. ×10 attenuator probe	PHILIPS PM 3230 PM 3220	B
Smoothing balance	RV 302, RV 602				G
Y amplifier balance	RV 353, RV 352 RV 651	DC-Voltmeter	Zero volt reading Sensitivity ≥ 100 kOhm/volt	PHILIPS PM 2340	F
Bridge balance	RV 101, RV 401				H
Rise time	RV 152 RV 102, RV 402	Pulse generator	Rise time ≤ 150 ps	Tektronix TU 5	D
Memory gate width	RV 351	Square wave generator	Output: 500 mV into 50 Ohm with flat top, 50 kHz Rise time ≤ 50 ns	PHILIPS GM 2324	C
Loop gain	RV 301, RV 601				E
Low frequency compensation	CV 101, CV 401 CV 102, CV 402 R 106, R 406				J
Y-gain	RV 7, RV 8 RV 354	Sine wave generator	Output: 800 mV_{p-p} ± 1% into 50 Ohm, 1–10 MHz	PHILIPS GM 2621	K
Adjustments	—	Extension cable	—	See list of parts	—
Rise time	—	Extension plug	—	See list of parts	—

Checking and adjusting IV

A. GENERAL

The adjusting elements and their functions are listed in chapter III.
The tolerances mentioned in the following text apply only to newly adjusted instruments. The values may differ from those given in the technical data, chapter II of the operating manual PM 3419A + PM 3419B.
In order to obtain a high degree of accuracy, it is best to make these adjustments with the aid of the APPROPRIATE PM 3410 basic equipment, which must be set correctly.
Do not preset internal controls unless the instrument has been repaired or is far out of adjustment.
The adjustments must be performed in the order given and after a warming-up period of at least half an hour for both the basic instrument and the plug-in unit.
The basic equipment must be switched off while the extension cable is being fitted to avoid damage to the transistors.

B. AVALANCHE VOLTS

1. Connect the PM 3419A to the basic instrument PM 3410 via the extension cable (instrument switched off).

   Set the controls of the units as follows:

   PM 3419 A

Y_A mV/cm	100 (Vernier in pos. CAL)
Y_A SHIFT	middle position
Mode S5	A
TRIGG.	A
NORMAL/ SMOOTHED	NORMAL

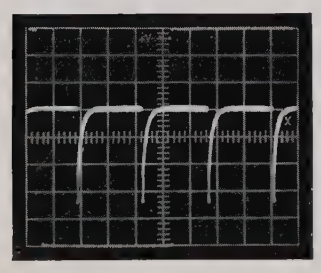


Fig. 2. Avalanche volts

   PM 3419 B

TIME/cm	0.2 µs
TIME SCALE MAGN.	1 (Vernier in pos. CAL)
X SHIFT	NORMAL
SENSITIVITY	fully counter clockwise
X DEFL.	10 samples/cm
TRIGG.	INT.—
TRIGG./SYNC.	TRIGG.

2. Connect the test oscilloscope 10 × attenuator probe to the collector of transistor Z151 (print 3). Set the controls of the test oscilloscope at 5 µs/div. and 2V/div. Trigger it internally.
3. Set TRIGG. on PM 3419 B to position FREE RUN and a display as in fig. 2 is shown.
4. Set TRIGG. on PM 3419 B in position INT.— and the display should disappear. If it does not, turn the AVALANCHE VOLTS, RV151, (print 3) about 5° anti-clockwise from the point where the waveform disappears.

C. MEMORY GATE WIDTH

1. Set the controls of the units as in B.1, but with TIME/cm in position 2 µs.
2. Connect the square wave generator output (50 kHz, 500 mV, less than 50 ns rise time) to input Y_A.
3. Adjust SENSITIVITY for internal triggering. Centre the step with X SHIFT.
4. Adjust MEMORY GATE WIDTH, RV351, (print 1) for maximum separation between the dots in the step.

D. RISE TIME

1. Set the controls of the units as follows:

   PM 3419 A

Mode S5	B
TRIGG.	B
NORMAL/ SMOOTHED	NORMAL

   PM 3419 B

TIME/cm	1 ns
TIME SCALE MAGN.	10 (Vernier in pos. CAL)
X DEFL.	100 samples/cm
TRIGG.	EXT. +
TRIGG./SYNC.	TRIGG.

2. Connect the pulse generator output (less than 150 ps rise time) to input Y_B.
3. Connect a trigger pulse from the pulse generator to TRIGG. IN on PM 3419 B. If no external trigger pulse is available on the pulse generator, connect the PM 3419 A to the basic instrument via the extension **plug** and use internal triggering.
   Adjust SENSITIVITY for triggering. Centre the step with X SHIFT and Y_B SHIFT.
4. Set Y_B mV/cm and Vernier to obtain a step amplitude of 8 cm.
5. Adjust RISE TIME RV152 (print 3) for 0.33 ns rise time (10% to 90% points on step).
6. Repeat points D.1 to D.4 for channel A and adjust A RISE TIME RV102 (print 2) for 0.33 ns rise time.
7. If adjustment D.6 does not succeed, set RV102 (print 2) in the middle position and adjust RISE TIME RV152 (print 3) for 0.33 ns rise time.
8. Repeat points D.1 to D.4 for channel B and adjust B RISE TIME RV402 (print 2) for 0.33 ns rise time.

E. LOOP GAIN

1. Set the controls of the units as follows:

PM 3419 A

Y_A mV/cm	100
Mode S5	A
TRIGG.	A
NORMAL/ SMOOTHED	NORMAL

PM 3419 B

TIME/cm	2 µs
TIME SCALE MAGN.	1 (Vernier in pos. CAL)
X DEFL.	10 samples/cm
TRIGG.	INT. +

2. Connect the square wave generator output (50 kHz, 500 mV, less than 50 ns rise time) to input Y_A.
3. Adjust SENSITIVITY for internal triggering. Centre the step with X SHIFT and Y_A SHIFT.

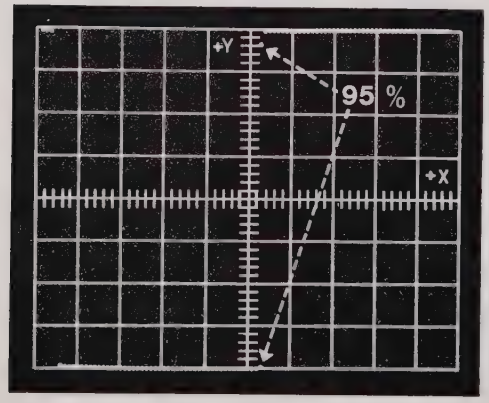


Fig. 3. Loop gain

4. Set Y_A mV/cm Vernier to obtain a step amplitude of 8 cm.
5. Adjust A LOOP GAIN RV301 (print 1) for about 95 % (76 mm) separation between the dots in the step. See fig. 3.
6. Repeat points E.1 to E.4 for channel B and adjust B LOOP GAIN RV601 (print 1) for about 95% separation between the dots in the step.

F. Y AMPLIFIER BALANCE

1. Set the controls of the units as follows:

PM 3419 A

Y_A mV/cm, Y_B mV/cm	200
Mode S5	A

PM 3419 B

TIME/cm	2 µs
TRIGG.	FREE RUN
X DEFL.	100 samples/cm

2. Connect a DC voltmeter to Y_A OUT.
   Adjust Y_A SHIFT for 0.0 V reading on the DC voltmeter.
3. Adjust A BAL. RV353 (print 1) for trace on middle line of graticule.
4. Repeat points F.1 and F.2 for channel B.
   Adjust B BAL. RV352 (print 1) for trace on middle line of graticule.
5. Set Mode S5 in position A and —B alternate. Adjust —B BAL RV651 (print 1) for trace on middle line of graticule.

G. SMOOTHING BALANCE

1. Set the controls of the units as follows:

PM 3419 A

Y_A mV/cm, Y_B mV/cm	5
Mode S5	A
Y_A SHIFT, Y_B SHIFT	middle position
NORMAL/ SMOOTHED	NORMAL

PM 3419 B

TIME/cm	0.2 µs
TIME SCALE MAGN.	1
X DEFL.	MANUAL
TRIGG.	FREE RUN

2. Connect the test oscilloscope × 10 attenuator probe to the collector of transistor Z302 (print 1). Set the controls of the test oscilloscope at 2 µs/div. and 2 mV/div. Trigger it externally from TRIGG. OUT on PM 3419 B.

3. Adjust A SMOOTHING BAL. RV302 (print 1) for minimum signal on the test oscilloscope. Centre the trace on the sampling oscilloscope with Y_A SHIFT when adjusting RV302.
4. Set Mode S5 in position B.
   Connect the test oscilloscope × 10 attenuator probe to the collector of transistor Z602 (print 1).
5. Adjust B SMOOTHING BAL. RV602 (print 1) for minimum signal on the test oscilloscope. Centre the trace on the sampling oscilloscope with Y_B SHIFT when adjusting RV602.

H. BRIDGE BALANCE

1. Set the controls of the units as in G.1, but X DEFL. in position 100 samples/cm.
2. Connect the DC voltmeter to wiper of Y_A SHIFT control. Adjust Y_A SHIFT to obtain a zero DC volt reading.
3. Connect the DC voltmeter to wiper of Y_A SHIFT Vernier control. Adjust Y_A SHIFT Vernier to obtain a zero DC volt reading.
4. Adjust A BRIDGE BAL. RV101 (print 2) for trace on middle line of graticule.
5. Set Mode S5 in position B. Repeat points H.2 and H.3 for channel B.
6. Adjust B BRIDGE BAL. RV401 (print 2) for trace on middle line of graticule.

J. LOW FREQUENCY COMPENSATION

1. Put the metal covers on printplate 2 of PM 3419 A before carrying out the following adjustments.
2. Set the controls of the units as follows:

PM 3419 A

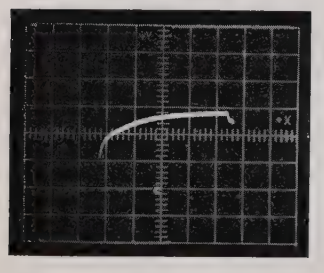
Y_A mV/cm, Y_B mV/cm	5 (Vernier in pos. CAL)
Mode S5	A
TRIGG.	A
NORMAL/SMOOTHED	NORMAL

PM 3419 B

TIME/cm	2 µs
TIME SCALE MAGN.	1 (Vernier in pos. CAL)
X DEFL.	100 samples/cm
TRIGG.	INT.—
TRIGG./SYNC.	TRIGG.

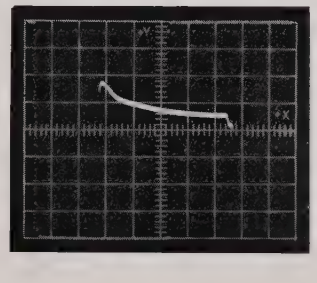
3. Connect the square wave generator output (50 kHz, 500 mV, less than 50 ns rise time) to input Y_A.
4. Adjust SENSITIVITY for internal triggering. Centre the top of the waveform with X SHIFT and Y_A SHIFT.
5. Adjust A FREQUENCY COMPENSATION CV101 and CV102 (print 2) simultaneously for a flat square wave with as little rounding at the corners as possible, as in fig. 4c.
6. If it is not possible to get a flat centre, change the resistor R106 (print 2) according to fig. 4 and repeat point J.5.
7. Repeat points J.2 to J.4 for channel B.
8. Adjust B FREQUENCY COMPENSATION CV401 and CV402 (print 2) simultaneously for a flat square wave with as little rounding at corners as possible, as in fig. 4c.
9. If it is not possible to get a flat centre, change the resistor R406 (print 2) according to fig. 4 and repeat point J.8.

Fig. 4. Low-frequency compensation



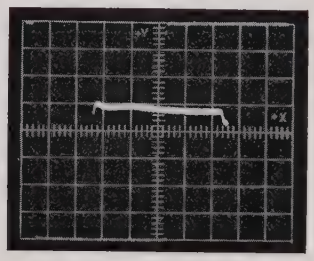
4a

Decrease the value of R106 (R406)



4b

Increase the value of R106 (R406)



4c

Correct adjusted

K. Y GAIN

1. Set the controls of the units as follows:

PM 3419 A

Y_A mV/cm	50 (Vernier in pos. CAL)
Y_B mV/cm	100 (Vernier in pos. CAL)
Mode S5	A VERT. B HOR.
TRIGG.	B
NORMAL/ SMOOTHED	NORMAL

PM 3419 B

TIME/cm	0.2 µs
TIME SCALE MAGN.	1 (Vernier in pos. CAL)
X DEFL.	100 samples/cm
TRIGG.	INT.—
TRIGG./SYNC.	TRIGG.

2. Connect the sine wave generator output (1 MHz, 800 $mV_{p-p} \pm 1\ \%$) to input Y_B and connect X OUT to input Y_A.
3. Adjust SENSITIVITY for internal triggering. Centre the display with Y_A SHIFT and Y_B SHIFT.
4. Adjust B CAL, RV8, to obtain 8 cm $\pm$ 0.1 of horizontal deflection.
5. Set Mode S5 to B. Remove the cable between X OUT and input Y_A. Centre the display with Y_B SHIFT.
6. Adjust Y GAIN, RV354, (print 1) to obtain 8 cm $\pm$ 0.1 of vertical deflection.
7. Set the controls of PM 3419 A:

Y_A mV/cm	100 (Vernier in pos. CAL)
Mode S5	A
TRIGG.	A

8. Connect the sine wave generator output to input Y_A instead of to input Y_B.
9. Centre the display with Y_A SHIFT.
10. Adjust A CAL, RV7, to obtain 8 cm $\pm$ 0.1 of vertical deflection.

Information for assistance in fault finding

To facilitate checking for correct operation and fault-finding, some oscillograms are given in figs. 9 and 12. These oscillograms were measured with a sampling oscilloscope at the points indicated on the circuit diagrams and printed wiring boards in Roman numerals.

Remark:

Whenever it is desired to send the plug-in units to a PHILIPS workshop the following points should be observed:

- give the symptoms of the fault as fully as possible
- tie on a label bearing the name and address of the sender
- carefully pack the instrument in the original packing or, if the latter is not available, in a wooden box.
- send the instrument direct to the appropriate PHILIPS address provided by the local organization.
- if the required units must be set with a high degree of accuracy, the appropriate basic instrument must be sent with the units.

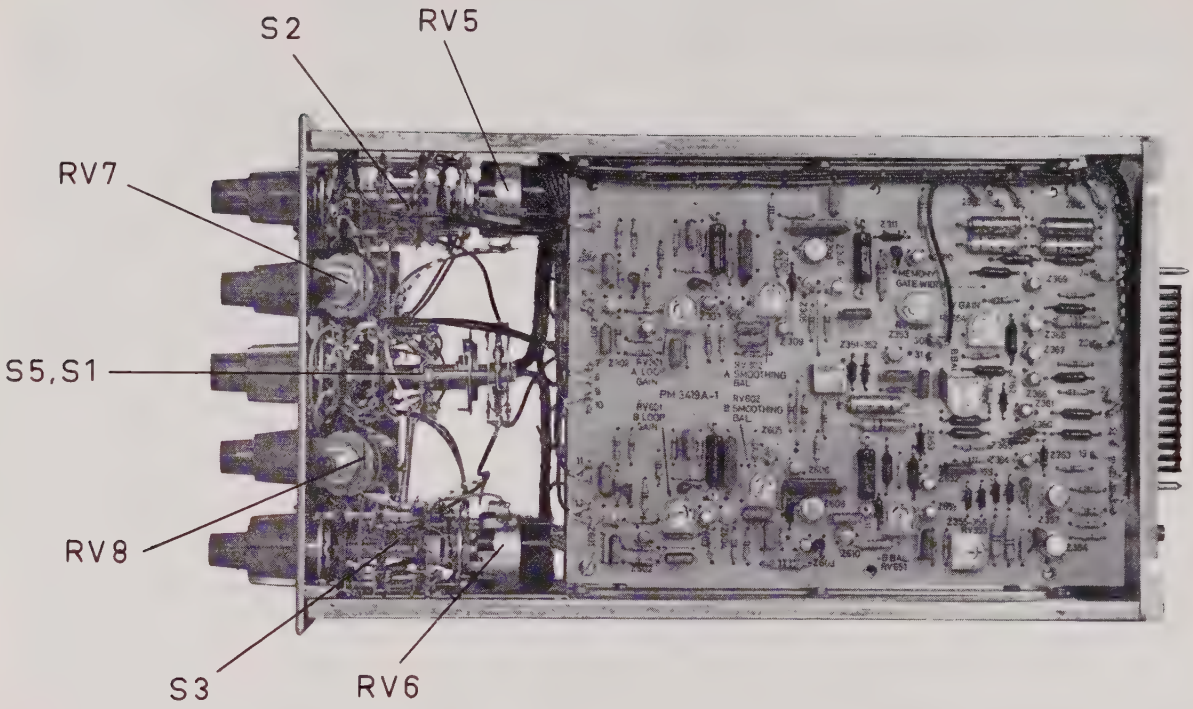


Fig. 5. Top view

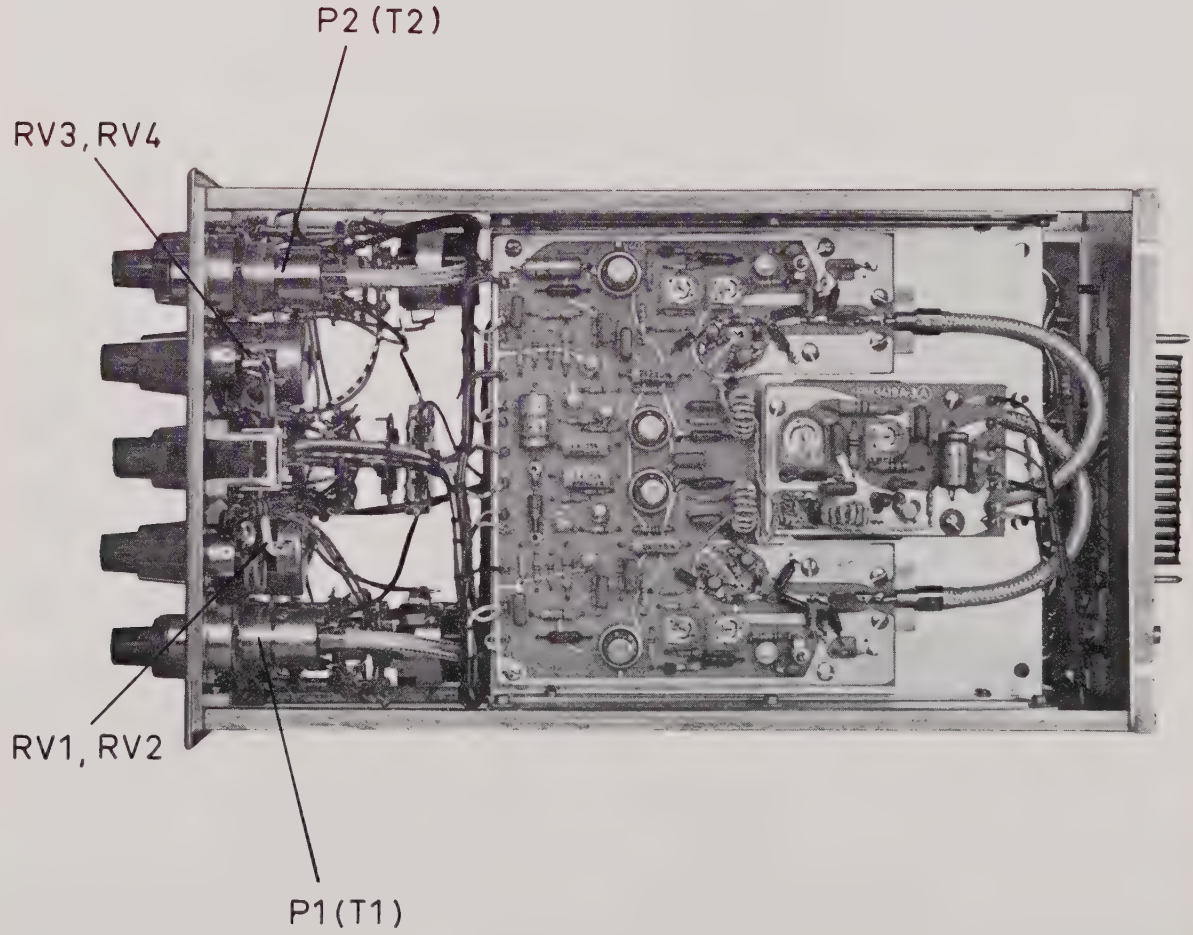


Fig. 6. Bottom view

List of parts

VI

A. MECHANICAL

Item	*Number*	*Code number*	*Description*
1	1	4822 454 40034	Textplate
2	2	4822 159 00363	Knob (RV1, 3)
3	3	4822 159 00318	Knob (S2, 3, 5)
4	1	4822 159 00321	Knob (S1)
5	4	4822 159 00359	Knob (RV2, 4, 5, 6)
6	5	4822 159 00358	Knob cap
7	2	4822 273 80088	Switch (S1, 5)
8	2	4822 273 40186	Switch (S2, 3)
9	1	4822 159 00421	Switch (S4)
10	2	4822 267 10026	Connector (P1, 2) (General Radio: 874 – PRL8A)
11	2	979/4×270	Connector (P3, 4) (Preh: 8–6079)
12	2	4822 216 00496	Connector (P5, 6)
13	1	W4 125 73	Plug B (Amphenol 26–159–32)

B. ELECTRICAL

No standard parts are included in this parts list.
The standard parts in the circuit diagrams (Figs. 10 and 13) are indicated with symbols from which the service code number can be derived.
The key to the code is given below:

	Carbon resistor	0.25 W	≤ 1 MΩ 5% > 1 MΩ 10%	902/K...
	Carbon resistor	0.5 W	≤ 10 MΩ 1% >10 MΩ 2%	901/...
	Carbon resistor	0.125 W	5%	902/A...
	Ceramic capacitor	500–700 V		904/...
	Ceramic "Pin-up" capacitor	500 V		904/P...
	Styroflex capacitor	500 V	1%	905/D...
	Ceramic trimmer			908/...

Example:

Code number 901/120K

Code number 904/4E7

RESISTORS

No.	*Code number*	*Value*	*%*	*Watt*	*Description*
R101	4822 071 00588	2.2 Ω	10	0.125	
R151	4822 071 00587	4.7 Ω	10	0.125	
R203	4822 071 00764	1 kΩ	1	0.05	
R213	B8 305 29D/30E	30 Ω	1	0.05	
R214	4822 116 50173	50 Ω	1	0.05	
R215	4822 071 00783	100 Ω	1	0.05	
R216	4822 071 00738	300 Ω	1	0.05	
R217	4822 071 00764	500 Ω	1	0.05	2 in parallel
R218	4822 071 00764	1 kΩ	1	0.05	
R219	4822 071 00791	2350 Ω	1	0.05	2 in parallel
R220	4822 071 00764	1 kΩ	1	0.05	
R221	4822 071 00764	500 Ω	1	0.05	2 in parallel
R222	4822 071 00738	300 Ω	1	0.05	
R223	4822 071 00783	100 Ω	1	0.05	
R224	4822 116 50173	50 Ω	1	0.05	
R225	4822 116 50173	50 Ω	1	0.05	
R401	4822 071 00588	2.2 Ω	10	0.125	
R503	4822 071 00764	1 kΩ	1	0.05	
R513	B8 305 29D/30E	30 Ω	1	0.05	
R514	4822 116 50173	50 Ω	1	0.05	
R515	4822 071 00783	100 Ω	1	0.05	

No.	*Code number*	*Value*	*%*	*Watt*	*Description*
R516	4822 071 00738	300 Ω	1	0.05	
R517	4822 071 00764	500 Ω	1	0.05	2 in parallel
R518	4822 071 00764	1 kΩ	1	0.05	
R519	4822 071 00791	2350 Ω	1	0.05	2 in parallel
R520	4822 071 00764	1 kΩ	1	0.05	
R521	4822 071 00764	500 Ω	1	0.05	2 in parallel
R522	4822 071 00738	300 Ω	1	0.05	
R523	4822 071 00783	100 Ω	1	0.05	
R524	4822 116 50173	50 Ω	1	0.05	
R525	4822 116 50173	50 Ω	1	0.05	
R651	4822 071 00792	10 kΩ	0.05	0.1	
R654	4822 071 00792	10 kΩ	0.5	0.1	

POTENTIOMETERS

No.	*Code number*	*Value*	*%*	*Watt*	*Description*
RV1, 2	4822 102 10076	2×50 kΩ	20	0.25	Duo potentiometer
RV3, 4	4822 102 10076	2×50 kΩ	20	0.25	Duo potentiometer
RV5	E 199 AA/B13B3K5	3.5 kΩ	10	1	
RV6	E 199 AA/B13B3K5	3.5 kΩ	10	1	
RV7	4822 071 00949	1.5 kΩ	5	2	
RV8	4822 071 00949	1.5 kΩ	5	2	
RV101	4822 100 10035	10 kΩ	10	0.25	
RV102	4822 100 10052	100 kΩ	10	0.25	
RV151	4822 100 10035	10 kΩ	10	0.25	
RV152	4822 100 10054	50 Ω	10	0.5	
RV301	4822 140 00393	2 kΩ	10	0.25	
RV302	4822 100 10036	5 kΩ	10	0.25	
RV351	4822 100 10054	50 Ω	10	0.25	
RV352	4822 100 10051	20 kΩ	10	0.25	
RV353	4822 100 10051	20 kΩ	10	0.25	
RV354	4822 100 10037	1 kΩ	10	0.25	
RV401	4822 100 10035	10 kΩ	10	0.25	
RV402	4822 100 10052	100 kΩ	10	0.25	
RV601	4822 140 00393	2 kΩ	10	0.25	
RV602	4822 100 10036	5 kΩ	10	0.25	
RV651	4822 100 10036	5 kΩ	10	0.25	

CAPACITORS

No.	*Code number*	*Value*	*%*	*Volt*	*Description*
C101	4822 122 50025	1200 pF	10	1000	
C105	4822 069 01093	10 nF	20	250	
C106	4822 069 01105	100 nF	20	250	
C108	4822 069 01105	100 nF	20	250	
C109	4822 069 01105	100 nF	20	250	
C111	4822 069 01105	100 nF	20	250	
C151	909/G6,4	6.4 µF	—10 +50	150	Electrolytic
C152	4822 069 01105	100 nF	20	250	
C153	4822 069 01105	100 nF	20	250	
C156	4822 069 01105	100 nF	20	250	
C158	909/G6,4	6.4 µF	—10 +50	150	Electrolytic

No.	*Code number*	*Value*	*%*	*Volt*	*Description*
C159	909/U64	64 µF	—10 +50	10	Electrolytic
C301	4822 069 01105	100 nF	20	250	
C303	4822 069 01105	100 nF	20	250	
C304	4822 069 01105	100 nF	20	250	
C306	4822 069 01105	100 nF	20	250	
C307	4822 069 01105	100 nF	20	250	
C309	4822 069 01105	100 nF	20	250	
C312	4822 069 01105	100 nF	20	250	
C313	4822 069 01105	100 nF	20	250	
C351	4822 069 01105	100 nF	20	250	
C352	4822 069 00882	10 µF	—10 +50	25	Electrolytic
C353	4822 069 01105	100 nF	20	250	
C354	4822 069 01093	10 nF	20	250	
C357	4822 069 01105	100 nF	20	250	
C358	4822 069 00957	4 µF	—10 +50	64	Electrolytic
C359	909/Z10	10 µF	—10 +50	25	Electrolytic
C360	4822 069 00957	4 µF	—10 +50	64	Electrolytic
C361	909/Z10	10 µF	—10 +50	25	Electrolytic
C401	4822 122 50025	1200 pF	10	1000	
C405	4822 069 01093	10 nF	20	250	
C406	4822 069 01105	100 nF	20	250	
C408	4822 069 01105	100 nF	20	250	
C409	4822 069 01105	100 nF	20	250	
C411	4822 069 01105	100 nF	20	250	
C601	4822 069 01105	100 nF	20	250	
C603	4822 069 01105	100 nF	20	250	
C604	4822 069 01105	100 nF	20	250	
C606	4822 069 01105	100 nF	20	250	
C607	4822 069 01105	100 nF	20	250	
C609	4822 069 01105	100 nF	20	250	
C612	4822 069 01105	100 nF	20	250	
C613	4822 069 01105	100 nF	20	250	

VARIABLE CAPACITORS

No.	*Code number*	*Value*	*%*	*Volt*	*Description*
CV102	4822 069 00871	4.5–20 pF		160	
CV402	4822 069 00871	4.5–20 pF		160	

COILS

No.	*Code number*	*Value*	*%*	*Description*
L101	4822 128 00274	2.2 µH	10	
L102	56 590 65/20			Ferroxcube tube
L103	56 590 65/20			Ferroxcube tube
L104	56 590 65/20			Ferroxcube tube
L105	56 590 65/20			Ferroxcube tube
L106	56 590 65/20			Ferroxcube tube
L107	56 590 65/20			Ferroxcube tube
L108	56 590 65/20			Ferroxcube tube
L151	56 590 65/20			Ferroxcube tube
L152	56 590 65/20			Ferroxcube tube

No.	*Code number*	*Value*	*%*	*Description*
L401	4822 128 00274	2.2 µH	10	
L402	56 590 65/20			Ferroxcube tube
L403	56 590 65/20			Ferroxcube tube
L404	56 590 65/20			Ferroxcube tube
L405	56 590 65/20			Ferroxcube tube
L406	56 590 65/20			Ferroxcube tube
L407	56 590 56/20			Ferroxcube tube
L408	56 590 65/20			Ferroxcube tube

TRANSFORMERS

No.	*Code number*
T1	4822 158 10116
T2	4822 158 10116
T101	4822 158 10115
T151	4822 158 10123
T351	
T401	4822 158 10115

MISCELLANEOUS

No.	*Code number*	*Description*
Print 1	4822 214 10028	Printed circuit board with components
Print 2	4822 214 10029	Printed circuit board with components
Print 3	4822 214 10031	Printed circuit board with components
DL1+DL2	4822 218 60071	Complete delay line unit with terminals

SEMI CONDUCTORS

No.	*Type*	*Description*
Z101	A671 Texas Instrument	Diode
Z102	A671 Texas Instrument	Diode
Z103	BSY38	Transistor
Z104	BSY38	Transistor
Z105	BSY38	Transistor
Z151	2N 2369	Diode
Z152	UNIG IN914 Texas Instrument	Diode
Z153	SZ30C Mullard	Zener diode
Z301	BSY38	Transistor
Z302	BC109	Transistor
Z303	BC109	Transistor
Z304	BSY38	Transistor
Z305	BSY38	Transitor
Z306	BSY38	Transistor
Z307	BA114	Diode
Z308	2N 2386 Texas Instrument	Transistor
Z309	BC 109	Transistor
Z310	BSY38	Transistor
Z311	BZY88/C5V1	Zener Diode
Z351	IN 4009	Diode
Z352	IN 4009	Diode
Z353	2N 2369	Transistor
Z354	ASY26	Transistor
Z355	IN 4009	Diode
Z356	IN 4009	Diode
Z357	ASY26	Transistor
Z358	IN 4009	Diode
Z359	IN 4009	Diode
Z360	IN 4009	Diode
Z361	BC109	Transistor

No.	*Type*	*Description*
Z362	BA114	Diode
Z363	IN 4009	Diode
Z364	BC109	Transistor
Z365	IN 4009	Diode
Z366	BC109	Transistor
Z367	BSY39	Transistor
Z368	BSY39	Transistor
Z369	BC109	Transistor
Z401	A671 Texas Instrument	Diode
Z402	A671 Texas Instrument	Diode
Z403	BSY38	Transistor
Z404	BSY38	Transistor
Z405	BSY38	Transistor
Z601	BSY38	Transistor
Z602	BC109	Transistor
Z603	BC109	Transistor
Z604	BSY38	Transistor
Z605	BSY38	Transistor
Z606	BSY38	Transistor
Z607	BA114	Diode
Z608	2N 2386 Texas Instrument	Transistor
Z609	BC109	Transistor
Z610	BSY38	Transistor
Z611	BZY88/C5V1	Zener Diode
Z651	BC109	Transistor
Z652	BC109	Transistor
Z653	BZY58	Zener Diode

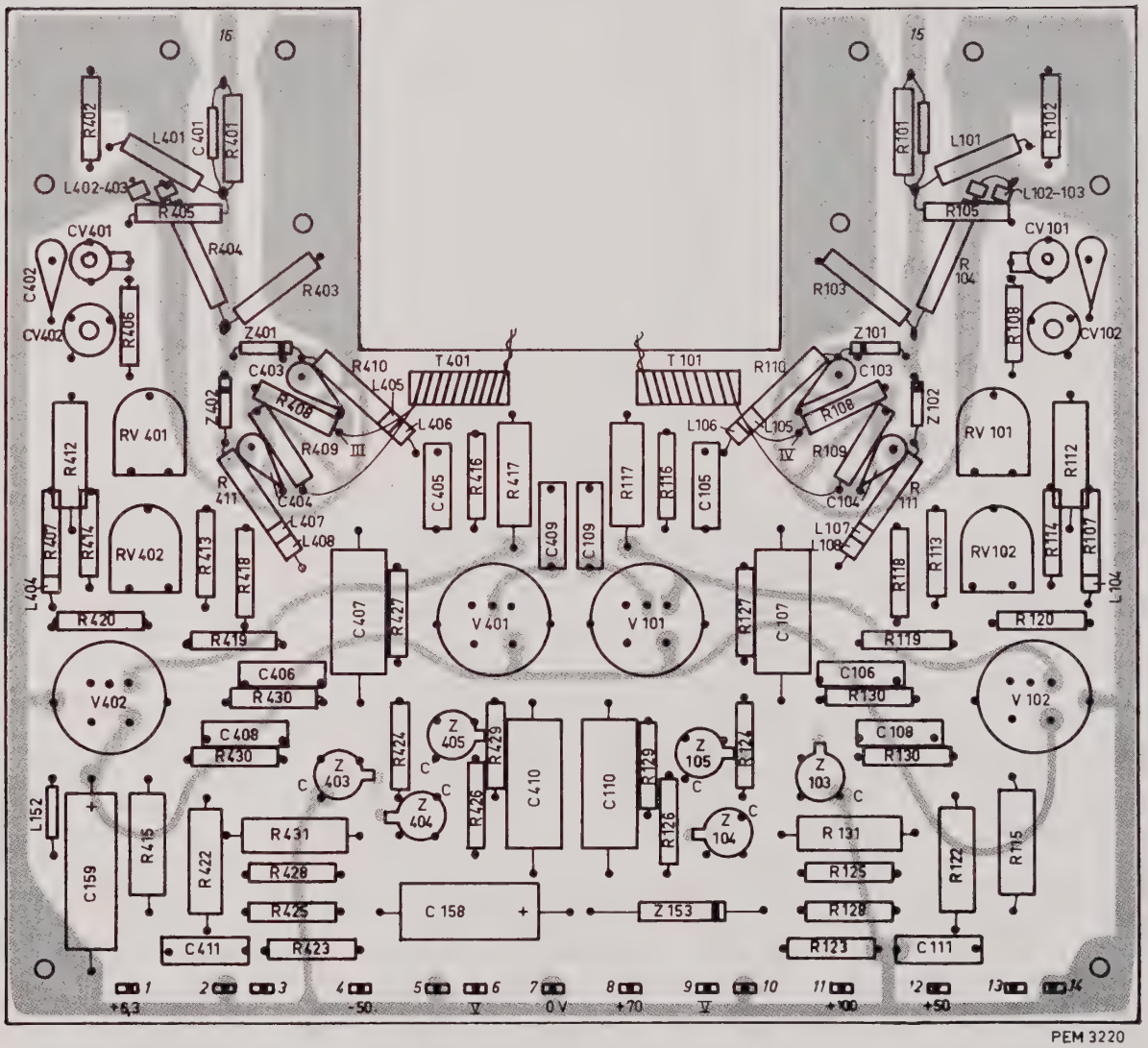


Fig. 7a. Printed circuit board 2, component side

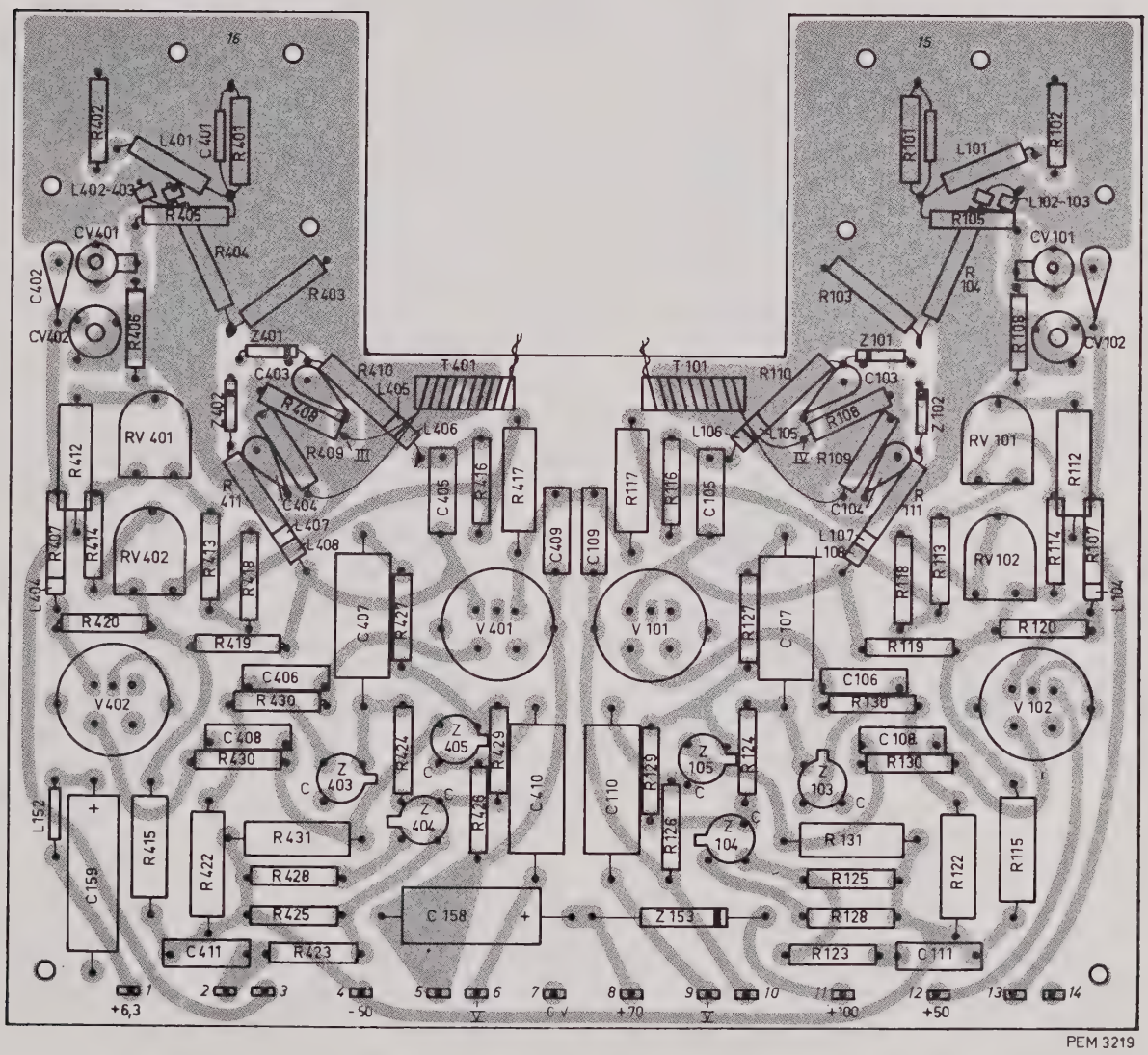


Fig. 7b. Printed circuit board 2, print side

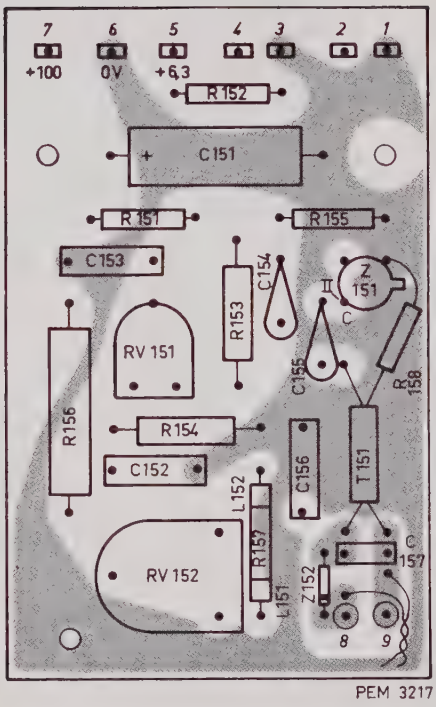


Fig. 8a. Printed circuit board 3, component side

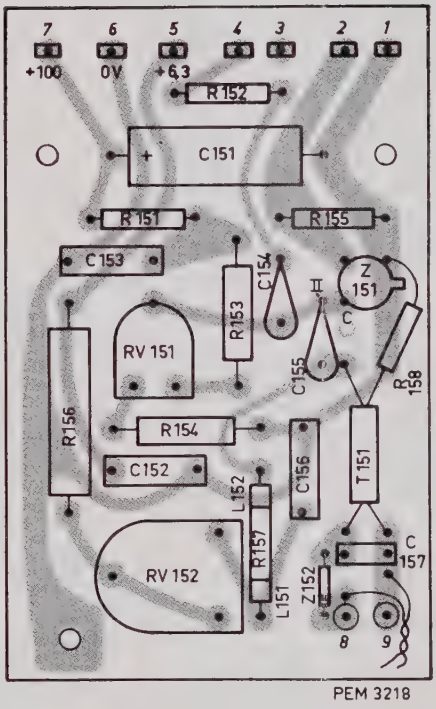
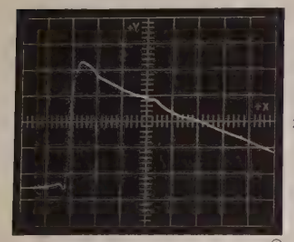
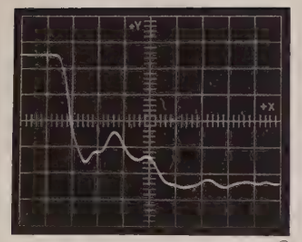


Fig. 8b. Printed circuit board 3, print side



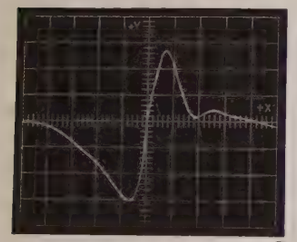
I.
Plug B(PM 3410), pin 29 over 50 Ω

The amplifier unit removed. Rise time 1.5 ns



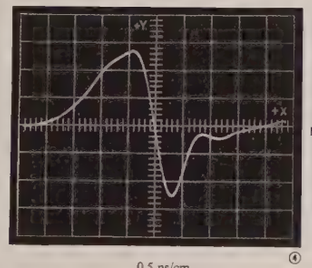
II.
Z 151 c

Rise time 1 ns



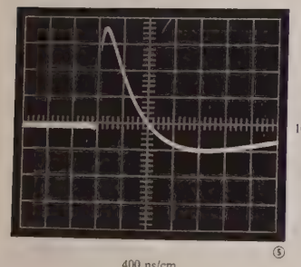
III.
C 403–T 401

S1 in position **B**



IV.
C 404–T 101

S1 in position A



V.
Print 2,

soldering point 6(9)

Soldering points 9 and 10 (1 and 2) on print 1 short-circuited. X SHIFT max. clockwise. (Opposite polarity of pulse when X SHIFT max. anti-clockwise.)
S1 in position B (A)

Fig. 9. Oscillograms

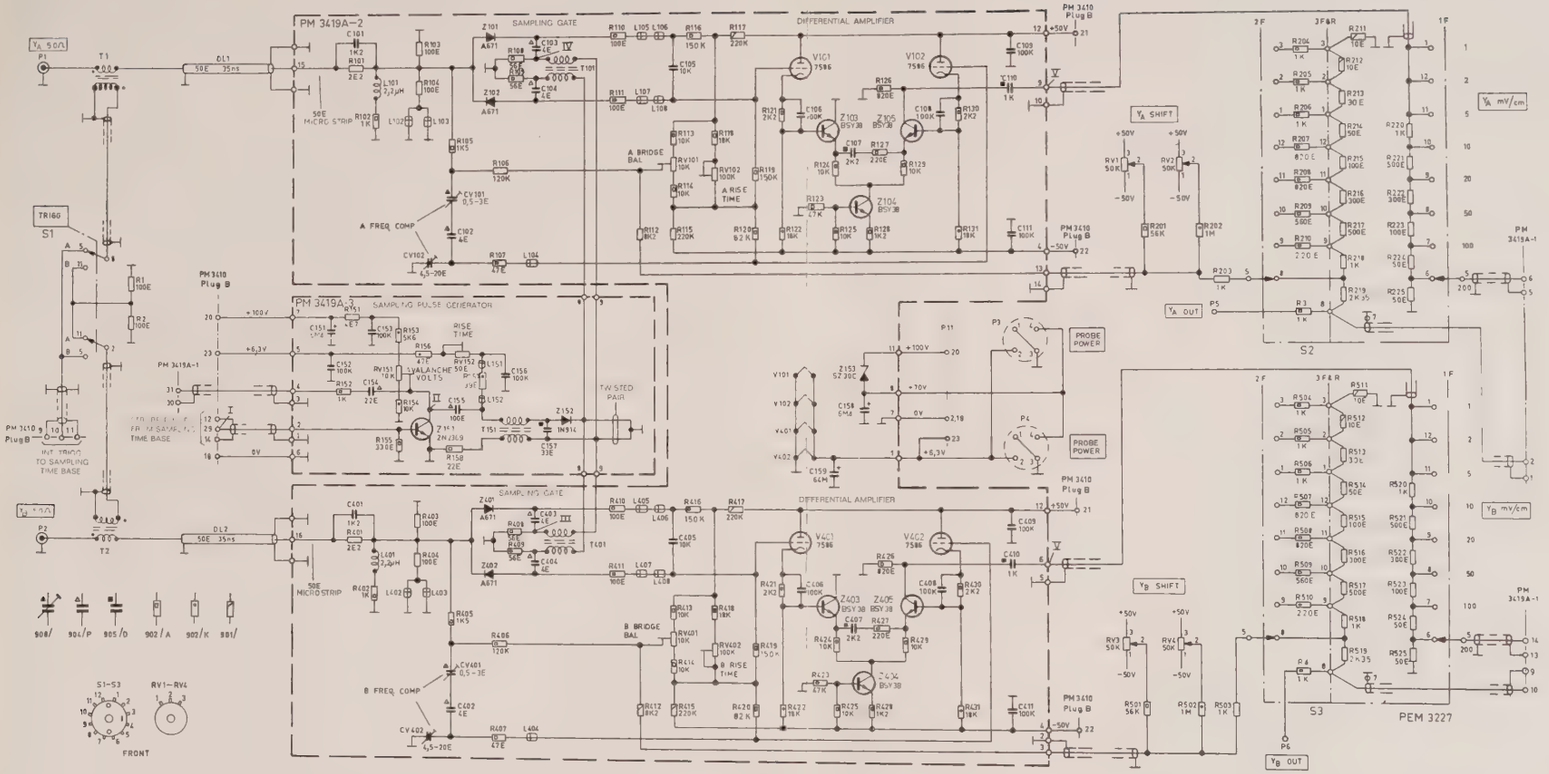


Fig. 10. Circuit diagram

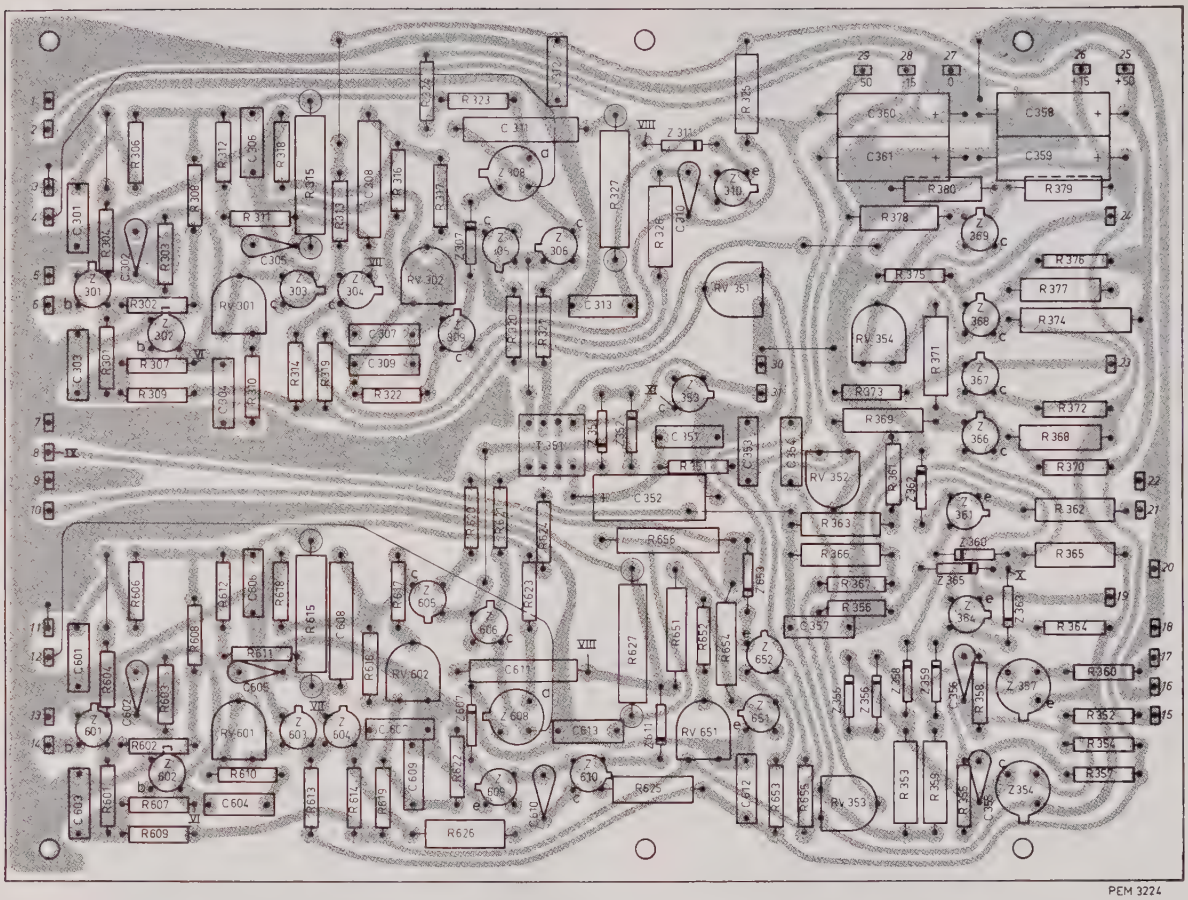
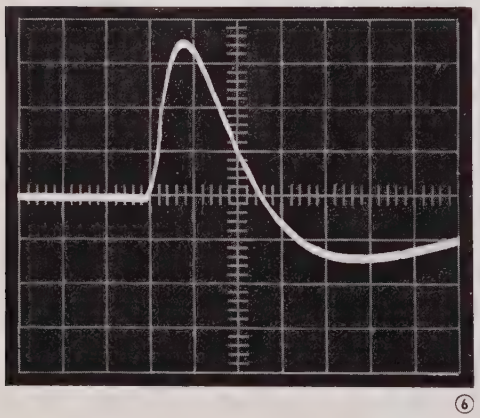


Fig. 11. Printed circuit board 1



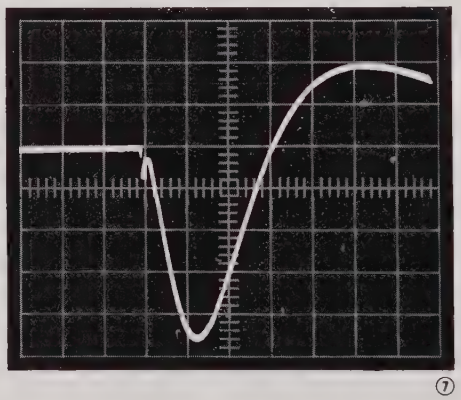
100 mV/cm

400 ns/cm

VI.

Z 602 c (Z 302 c)

Soldering points 9 and 10 (1 and 2) on print 1 short-circuited.
X SHIFT max. clockwise. (Opposite polarity of pulse when X SHIFT max. anti-clockwise.)
S3 (S2) in position 200 mV/cm.
S1 in position B(A).



0.5 V/cm

400 ns/cm

VII.

Z 604 e (Z 304 e)

Soldering points 9 and 10 (1 and 2) on print 1 short circuited.
X SHIFT max. clockwise.
S3 (S2) in position 200 mV/cm.

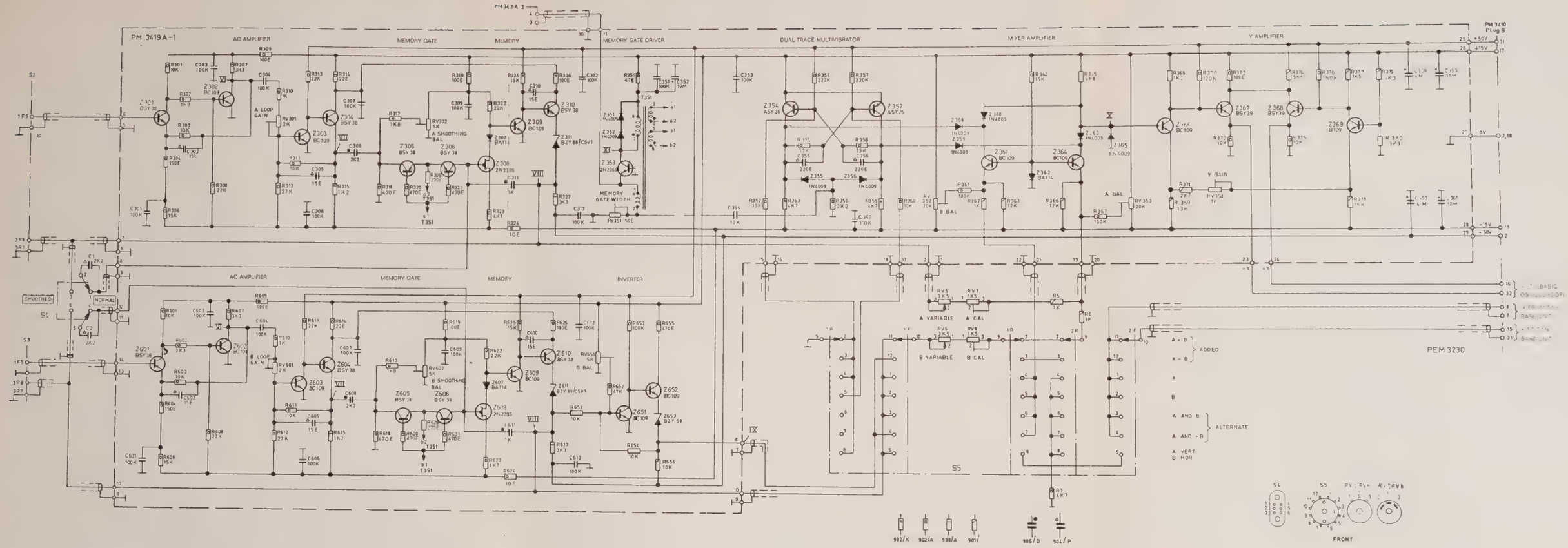
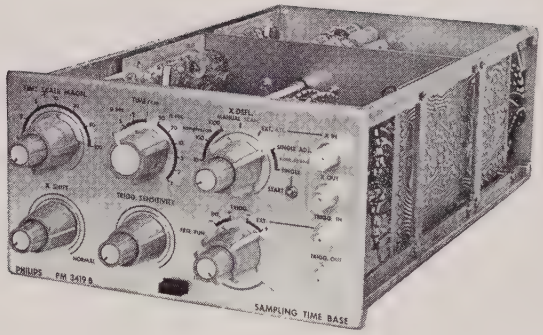


Fig. 13. Circuit diagram

PHILIPS



Service manual

PM 3419 B — Sampling time base unit

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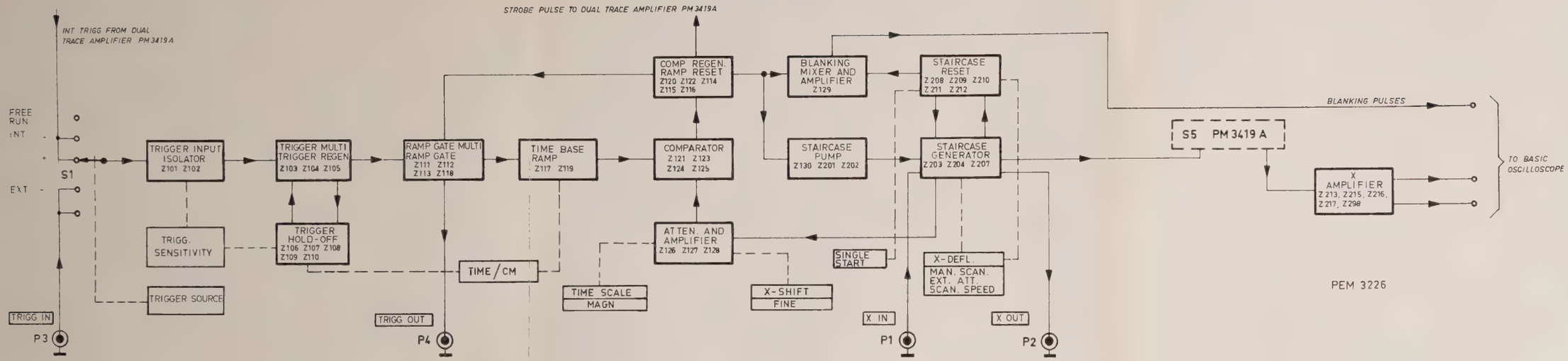
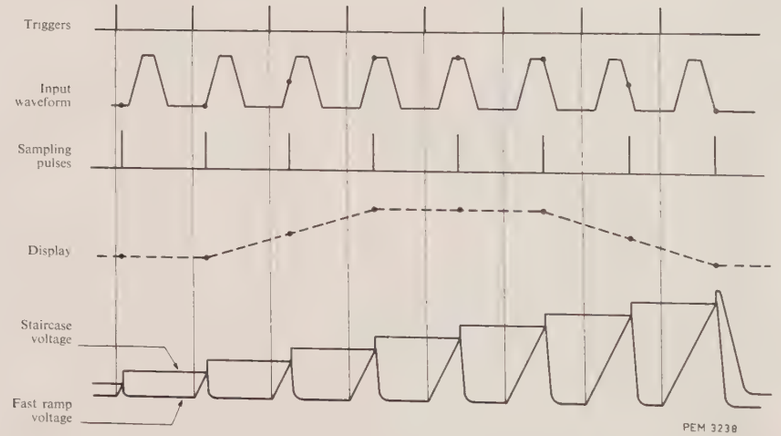


Fig. 1. Block diagram

Fig. 2. The sampling principle



Description of the block diagram

The major functional parts of the Sampling Time Base PM 3419 B are:

1. The trigger circuits
2. The time base circuits
3. The horizontal deflection circuits.

The trigger circuits serve two important functions, viz: recognition of a certain part of the input waveform for triggering and for frequency count-down. The circuit responds to input signals with repetition rates from single pulses up to 1000 MHz. For frequencies below about 20 MHz the trigger system selects a trigger and presents a steady display even when the triggers are randomly spaced. The sampling rate is limited by the recovery time of the circuits in the Sampling Dual Trace Amplifier PM 3419 A to 100 kHz and by the time base circuits to about 30 times the sweep time/cm. Therefore, a hold-off and count-down circuit is used to provide triggering for frequencies above the maximum sampling rate. For input frequencies above 20 MHz the synchronizing mode usually gives less time jitter than the triggering mode.

Each time the trigger circuits are actuated a fast ramp is started. The slope of this ramp determines the real time scale. The ramp voltage is compared to a staircase voltage in a comparator circuit. A strobe pulse is generated at the moment when the ramp voltage is equal to the staircase voltage. The strobe pulse is transferred to PM 3419 A, where it initiates the sampling pulse. It also goes into a diode pump circuit, which increases the staircase voltage one step. This means that the next strobe pulse is generated somewhat later, because it takes a longer time for the ramp voltage to reach the new level of the staircase. As a consequence of this the sampling is also delayed. The second sample therefore represents a later part of the input waveform See Fig. 2.

The real time scale is changed by changing the slope of the fast ramp.

The horizontal deflection on the CRT is taken from the staircase and can be varied completely independently of the real time scale. The height of the individual step determines the number of samples taken per cm of the CRT, and it can be varied in steps of 10, 100 or 1000 samples/cm. Time scale magnification is realized by attenuation of the staircase voltage before it is applied to the comparator. In that way all the samples are taken from a smaller part of the fast ramp and consequently the time scale is enlarged with constant number of samples/cm. Further possibilities for the X deflection can be achieved by replacing the staircase voltage by a voltage determined by a potentiometer. By turning the potentiometer the input signal waveform can be manually scanned. External deflection voltage or an internally generated slow sawtooth can also be used.

Circuit description

Trigger circuits

The trigger signal can be selected either from an external source or internally from one of the trigger take-off transformers in the PM 3419 A Dual Trace Amplifier. The triggers can be either positive or negative.

For example when an internal negative signal is used, the signal path is from the trigger take-off transformer in PM 3419 A to section 5F & R in the switch S1 and further to section 3F & R through transformer T1 and, via section 2F & R, to the base of transistor Z101. A positive input signal is phase-inverted in transformer T1 before it is supplied to the base of Z101. The transistors Z101 and Z102 together, make an AC coupled differential amplifier the function of which is to form a trigger input isolator stage. The trigger multivibrator stage consists of the tunnel diode Z103, the transistor Z104 and the inductance L104. The multivibrator is free running in the drawn position of the switch S1 ("TRIGG"), because the current via R108 and section 1F in the switch S1 exceeds the peak current of the tunnel diode Z103. In "SYNC." position of S2 ("TRIGG/SYNC.") the multivibrator is astable over the whole range of RV1 ("TRIGG. SENSITIVITY") for synchronization of frequencies above 20 MHz. The multivibrator can run up to about 20 MHz and synchronize to frequencies up to 1000 MHz.

Together with the trigger hold-off circuit (Z106, Z107, Z108, Z109 and Z110) the trigger regenerator (Z105) has a gate function which limits the sampling frequency to 100 kHz. When a negative step from Z103 appears at Z105 this tunnel diode switches on, and the transistor Z110 is conducting. When Z110 is conducting the hold-off capacitor C106 starts discharging from —15 V to earth. Depending on the position of the switch S3 ("TIME/cm") one of the capacitors C2, C3, C4, C5 or C6 will be connected in parallel with C106. When the capacitors are discharged to near zero the transistors Z106 and Z107 are cut off and the bias-current to the tunnel diode Z105 is removed. When the bias-current disappears the tunnel diode switches back to its initial stage, which means that the negative voltage at the base of Z110 also disappears. The hold-off capacitors will now be charged through R116 and RV2. When the voltage at C106 reaches —15 V the charging current is fed through Z108, the transistors Z106 and Z107 start to conduct again and the bias-current to the tunnel diode can flow. The trigger regenerator tunnel diode Z105 is now ready to switch on for the next negative step from the trigger multivibrator tunnel diode Z103.

Fast ramp

The negative step from Z105 also starts the ramp gate multivibrator Z113. The ramp gate transistor Z118 is cut off by means of the negative step from Z113. When Z118 is cut off the time base ramp starts. The time base ramp circuit consists of the transistor Z117, the zener diode Z119 and the capacitors CV1—CV3 and C7—C19 in section 2F of the switch S3 ("TIME/cm"). Depending on the position of the switch S3 some of these capacitors start charging by means of a constant current from Z117. Therefore, a linear ramp voltage appears at the base of Z121.

The negative step from Z113 is also fed to the amplifier stage Z112 and from the collector of this transistor a trigger signal is supplied to connector P4 ("TRIGG. OUT") for triggering external equipment.

Comparator

The comparator consists of a DC coupled differential amplifier Z121 and Z125 and a tunnel diode Z120. Z121 is normally not conducting and Z125 carries the current from R141. At a certain level (which depends on the voltage on the base of Z125) current starts to flow through Z121 and this transistor takes over the current. The tunnel diode Z120 switches on when the current through Z121 together with the bias-current exceeds the peak point current of the tunnel diode. A negative step is delivered from Z120 and is fed to the base of transistor Z122. From the collector of Z122 a positive strobe pulse is fed to the sampling pulse generator in the Sampling Dual Trace Amplifier PM 3419 A.

The step from the tunnel diode Z120 is also fed to transistor Z115 and further to Z114. The tunnel diodes Z113 and Z120 are then reset by the current through Z114. When Z113 is reset Z118 is conducting again and the ramp slope capacitors are discharged through Z118.

Blanking

A pulse is fed from the collector of Z115 to the bases of Z129 and Z130. Z129 is an amplifier for blanking pulses to the CRT. Z129 receives blanking pulses both from the collector of Z115 and the collector of Z212. From the collector of Z129 blanking pulses are fed to the Basic Oscilloscope, where they extinguish the spot during a short time after each sampling when the vertical deflection is changed and during the reset time of the sweep.

Staircase generator and X deflection

The staircase generator consists of Z203, Z204 and Z207, connected to form a DC amplifier, and a feedback capacitor, C209 or C210, connected between the output and the input of this amplifier. Temperature compensation of Z203 and Z204 is effected by the diodes Z205 and Z206. The base current to Z203 is adjusted via the potentiometer RV201 ("BAL"). The circuit can be driven either by pump pulses from the capacitor C21 or C22 or by a DC current.

Depending on the position of the switch S5 ("X DEFL.")

10, 100 or 1000 samples/cm can be made. Capacitors C210 and C21 are connected in position 10 samples/cm, capacitors C210 and C22 in position 100 samples/cm, and capacitors C209 and C22 in position 1000 samples/cm. In these positions of S5, a staircase-shaped voltage is built up on the emitter of Z207 by means of the pump-pulses from C21 or C22. These pump-pulses are supplied from the collector of Z130. The voltage at the emitter of Z207 is fed both to the connector P2 ("X OUT") for external use and via the switch S4 ("TIME SCALE MAGN.") to the comparator. The voltage from Z207 is also fed to the emitter of Z213 via R206 and the switch S5 in the Sampling Dual Trace Amplifier PM 3419 A and further to the X amplifier.

The increasing staircase voltage on the emitter of Z207 results in an increasing current to the tunnel diode Z210 via R212, Z209, RV202 ("SWEEP LENGTH") and R213. When the peak current of Z210 is reached, the tunnel diode switches on, which results in a positive step at the collector of Z212. This positive step is fed to the base of Z208 via resistor R211. Z208 starts conducting by this step and the capacitors C209 and C210 will be discharged. Consequently the staircase generator is reset. The step from the collector of Z212 is also fed to the base of Z129 and used for blanking of the CRT during the sweep reset. When the staircase generator is reset, the tunnel diode Z210 is switched off by the next negative pump-pulse from the collector of Z130 via R21.

If the switch S5 is set in position "SINGLE ADJ." or "SINGLE" no pump-pulses are fed to the base of Z203 but a DC current via R23 from RV7 ("scan speed"). By means of this potentiometer the scan speed can be adjusted. When S5 is set in position "SINGLE" no reset pulses are fed to the tunnel diode Z210, but the tunnel diode is now reset by the push-button S6 ("SINGLE START").

In positions "MANUAL" and "EXT." the staircase generator is disconnected. In position "MANUAL" a DC voltage from RV7 ("SCAN") is fed via deck 3R to the base of Z207. Consequently manual scanning can be effected by means of the potentiometer RV7 in this case. When S5 is set in position "EXT." the same potentiometer RV7 ("ATT") functions as an attenuator for the input signal to connector P1 ("X IN").

Therefore, depending on the position of the switch S5, the waveforms on the emitter of Z207 can be as shown in Fig. 3.

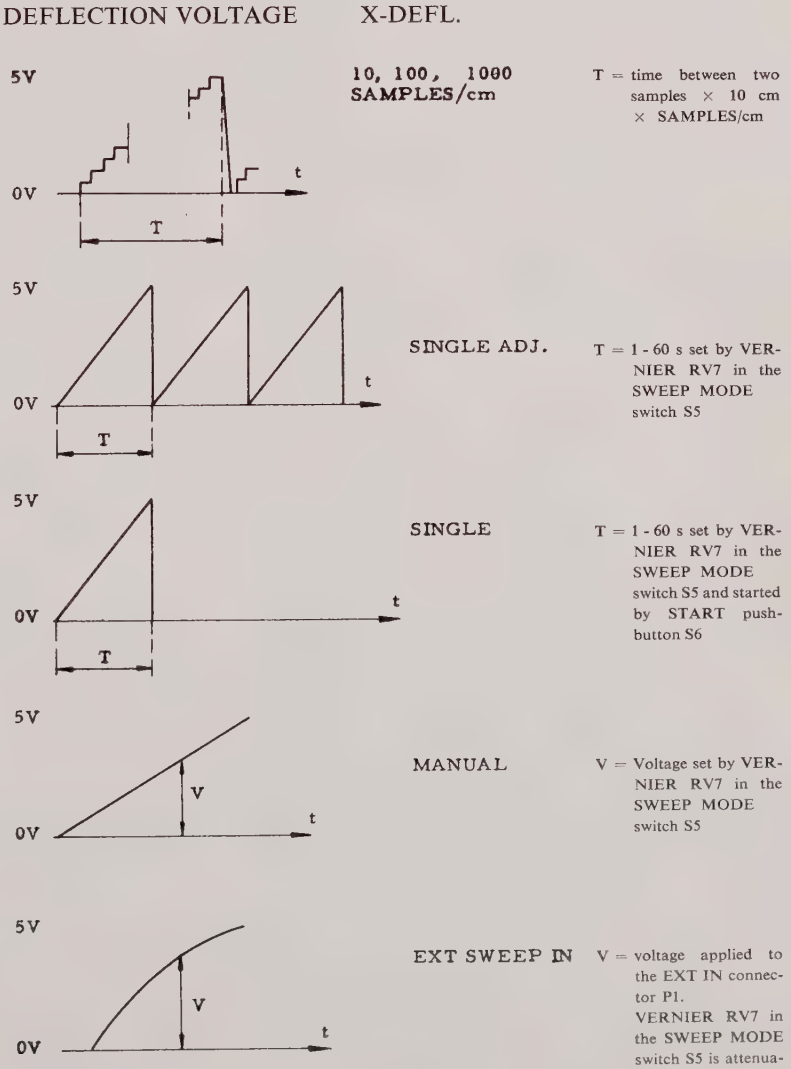

DEFLECTION VOLTAGE
X-DEFL.
5V
0V
t
T
10, 100, 1000 SAMPLES/cm
T = time between two samples × 10 cm × SAMPLES/cm
SINGLE ADJ.
T = 1 - 60 s set by VERNIER RV7 in the SWEEP MODE switch S5
SINGLE
T = 1 - 60 s set by VERNIER RV7 in the SWEEP MODE switch S5 and started by START push-button S6
MANUAL
V
V = Voltage set by VERNIER RV7 in the SWEEP MODE switch S5
EXT SWEEP IN
V = voltage applied to the EXT IN connector P1. VERNIER RV7 in the SWEEP MODE switch S5 is attenuator
PEM 3239

Fig. 3. Different sweep mode switch positions

Time scale magnifier

As mentioned earlier, current starts to flow through Z121 at a certain level of the ramp voltage on the base of Z121. Because the comparator Z121 and Z125 is a differential amplifier this level depends on the voltage level on the base of Z125. The voltage on the base of Z125 is determined by the output voltage from the staircase generator and the position of the switch S4 ("TIME SCALE MAGN."). The resistors R13-R18 on S4 form an attenuator which attenuates the staircase voltage from Z207. A constant current flows through the emitter-follower Z128 and the resistors R7-R12 and the potentiometers RV5 ("DELAY ZERO"), RV3 ("X SHIFT VERNIER") and RV4 ("X SHIFT"). The staircase voltage is fed from RV3 to the comparator via an emitter-follower Z126.

The design is such that the magnifier function always enlarges around the middle-point of the screen. This is achieved by means of R7–R12 on the switch S4 and the X SHIFT function. The X SHIFT is in reality a time-delay. In position "NORMAL" the delay is zero. It is always possible to delay as much as a full, unmagnified sweep. The delay remains unchanged by the magnifier. For instance, when the time/cm is 1 ns/cm a full sweep is 10 cm times 1 ns or 10 ns, which is equal to the delay range.

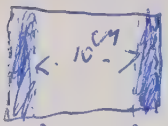
X amplifier

The X amplifier consists of the transistors Z215–Z218 which form a differential amplifier. The staircase voltage on the emitter of Z207 is fed via S5 in PM 3419 A and transistor Z213 to the X amplifier. The balance of the X amplifier is adjusted with potentiometer RV8 ("X POS."). The X gain can be adjusted by means of the potentiometer RV9 ("X GAIN"). The X deflection voltage to the Basic Oscilloscope is fed from the emitter-followers Z216 and Z217.

Adjusting elements and their functions

III

Adjustment	*Adjusting elements*	*Instrument required*	*Specifications*	*Proposed model*	*Chapter IV section*
X-amplifier	RV8, RV9	Digital voltmeter or calibrated oscilloscope	Input impedance > 100 kΩ Accuracy: 1% at 6 V	PHILIPS PM 3206 (calibrated)	B
Delay zero	RV8, RV5 RV202	Square wave generator	Output: 1 V_{p-p}, 200 kHz Rise time < 50 ns	PHILIPS GM 2324	D
Triggering	RV101, RV102 RV103, RV104	Sine wave generator	Output: 100 mV_{p-p}, 10 MHz	PHILIPS GM 2621	C
Time calibration	RV105, CV1 CV2, CV3	Sine wave generator	Output: 200–300 mV_{p-p}, 1 and 100 MHz ± 1%	PHILIPS GM 2621	F
X-deflection	RV201	—	—	—	E
Adjustments	—	Extension cable	—	See list of parts	—



IV

Checking and adjusting

A. GENERAL

The adjusting elements and their functions are listed in chapter III.
The tolerances mentioned in the following text apply only for newly adjusted instruments. The values may differ from those given in the technical data, chapter II of the operating manual PM 3419A + PM 3419B.
In order to obtain a high degree of accuracy, it is best to make these adjustments with the aid of the appropriate PM 3410 basic equipment, which must be set correctly.
Do not adjust the internal controls unless the instrument has been repaired or is much out of adjustment. The adjustments must be performed in the order given and after a warming-up period of at least half an hour for both the basic instrument and the plug-in unit.
The basic equipment must be switched off while the extension cable is being fitted to avoid damage to the transistors.

B. X-AMPLIFIER

1. Connect the PM 3419 B to the basic instrument via the extension cable (instrument switched off). This applies to all adjustments except the adjustment of DELAY ZERO.
2. Short-circuit the pins 9 and 10 on print 1 of the amplifier unit PM 3419A.
3. Connect the voltmeter to X OUT, P2 and set the controls of the units as follows:

PM 3419 A

Y_A mV/cm	50 (Vernier in pos. CAL)
Y_A SHIFT	middle position
Mode S5	B
TRIGG.	A
NORMAL/ SMOOTHED	NORMAL

PM 3419 B

TIME/cm	0.1 µs
TIME SCALE MAGN.	1 (Vernier in pos. CAL)
X SHIFT	NORMAL
SENSITIVITY	middle position
X DEFL.	MANUAL
TRIGG.	FREE RUN
TRIGG./SYNC.	TRIGG.

4. Turn MANUAL SCAN, RV7, until the voltmeter shows 0.0 V.
5. Adjust the dot to the extreme left-hand vertical line with X POS, RV8.
6. Turn MANUAL SCAN, RV7, until the voltmeter shows 5.0 V.
7. Adjust the dot to the extreme right-hand vertical line with X GAIN, RV9.
8. Repeat points B.4 to B.7 until the error is within 1 mm.
9. Remove the short circuit mentioned in point B.2.

C. TRIGGERING

1. Set the controls of the units as follows:

PM 3419 A

Y_A mV/cm	100 (Vernier in pos. CAL)
Y_A SHIFT	middle position
Mode S5	A
TRIGG.	A
NORMAL/ SMOOTHED	NORMAL

PM 3419 B

TIME/cm	50 ns
TIME SCALE MAGN.	1 (Vernier in pos. CAL)
X SHIFT	NORMAL
SENSITIVITY	middle position
X DEFL.	100 samples/cm
TRIGG.	INT. +
TRIGG./SYNC.	TRIGG.

2. If no triggering is obtained:
   Set RV101 (print 1) fully anti-clockwise, RV102 (print 1) fully clockwise and RV104 (print 1) in middle position.
   Adjust RV103 (print 1) just until a trace appears. If no trace appears try another position of RV104 and adjust RV103 again.
   Repeat these adjustments until a trace appears.
   Turn RV102 just until the trace disappears.
3. Adjust RV101 until the trace appears and turn back to the point where the trace just disappears.
4. Apply a signal (from a sine wave or pulse generator) with an amplitude of 100 mV_{p-p} and a frequency of about 10 MHz to the input Y_A, P1.
5. Adjust SENSITIVITY for triggering.
6. Adjust RV103 to the middle of the range within which a correct display is obtained.
7. Adjust RV104 to the middle of the range within which a correct display is obtained.
8. Adjust RV102 to the middle of the range within which a correct display is obtained.

D. DELAY ZERO, X POSITION AND SWEEP LENGTH

1. The unit must be inserted in the Basic Oscilloscope when adjusting DELAY ZERO. The adjusting elements can be reached after removing the top plate of the oscilloscope.
   Set the controls of the units as follows:

PM 3419 A

Y_A mV/cm	200 (Vernier in pos. CAL)
Mode S5	A
TRIGG.	A
NORMAL/ SMOOTHED	NORMAL

PM 3419 B

TIME/cm	1 µs
TIME SCALE MAGN.	1 (Vernier in pos. CAL)
X SHIFT	both in pos. NORMAL
X DEFL.	100 samples/cm
TRIGG.	INT. +
TRIGG./SYNC.	TRIGG.

2. Apply a positive to Y_A input, P1.
   Amplitude 1 V
   Rise time < 50 ns
   Frequency about 200 kHz
3. Adjust SENSITIVITY to display the signal.
4. Adjust X POS. RV8 so that the start of the trace is shown on the CRT.
5. Adjust DELAY ZERO RV5 so that the trace starts with the leading edge of the signal.
6. Adjust X POS. RV8 so that the leading edge coincidences with the extreme left vertical line.
7. Adjust SWEEP LENGTH RV202 (print 2) so that the trace has a length of about 105 mm.

E. X DEFLECTION

1. Short circuit pins 9 and 10 on the printed circuit board 1 of the amplifier unit PM 3419 A.
2. Set the controls of the units as follows:

PM 3419 A

Mode S5	B

PM 3419 B

X DEFL.	100 samples/cm
TRIGG.	INT. +
TRIGG./SYNC.	TRIGG.

3. Advance the SENSITIVITY until the trace free-runs, then decrease the SENSITIVITY until the spot stops on the CRT.
4. Adjust BAL RV201 for as slow a dot movement as possible.
5. Remove the short circuit mentioned in point E.1.

F. TIME CALIBRATION

1. Set the controls of the units as follows:

PM 3419 A

Y_A mV/cm	100 (Vernier in pos. CAL)
Mode S5	A
TRIGG.	A
NORMAL/ SMOOTHED	NORMAL

PM 3419 B

TIME/cm	1 µs
TIME SCALE MAGN.	1 (Vernier in pos. CAL)
X SHIFT	middle position
X DEFL.	100 samples /cm
TRIGG.	FREE RUN
TRIGG./SYNC.	TRIGG.

2. Position the line exactly in de middle of the screen with Y SHIFT.
3. Next set the triggering selector in position INT. +.
4. Apply a signal (from a sine wave or pulse generator) with a frequency of 1 MHz ± 1% and an amplitude of 200–300 mV_{p-p}.
5. Set SENSITIVITY for triggering.
6. Adjust RAMP CURRENT RV105 (print 1) so that 10 periods fill 10 cm.
7. Set the frequency of the generator to 100 MHz ± 1%.
8. Set TIME/cm to 1 ns, TRIGG./SYNC. to SYNC. and Y_A mV/cm to 20. Adjust RAMP SLOPE CAPACITOR CV3 so that 1 period fills 10 cm.
9. Set TIME/cm to 2 ns.
   Adjust CV2 so that 2 periods fill 10 cm.
10. Set TIME/cm to 5 ns and Y_A mV/cm to 50.
    Adjust CV1 so that 5 periods fill 10 cm.

Information for assistance in fault finding

To facilitate checking for correct operation and fault-finding, some oscillograms are given in Fig. 7.
These oscillograms were measured with a sampling oscilloscope at the points indicated on the circuit diagrams and printing wiring boards in Roman numerals.

Remark:

Whenever it is desired to send the plug-in units to a PHILIPS workshop the following points should be observed:

- give the symptoms of the fault as fully as possible.
- tie on a label bearing the name and address of the sender.
- carefully pack the instrument in the original packing or, if the latter is not available, in a wooden box.
- send the instrument direct to the appropriate PHILIPS address provided by the local organization.
- if the repaired units must be set with a high degree of accuracy, the appropriate basic instrument must be sent with the units.

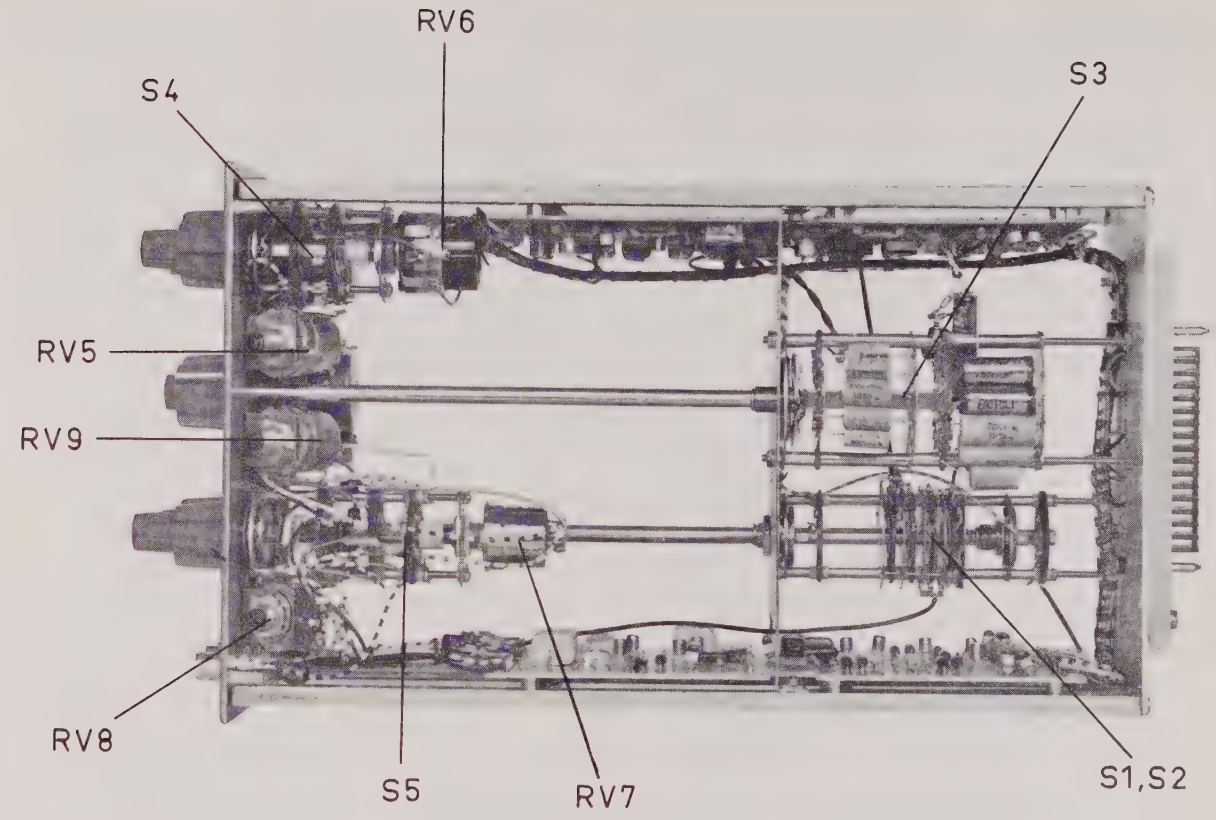


Fig. 4 Top view

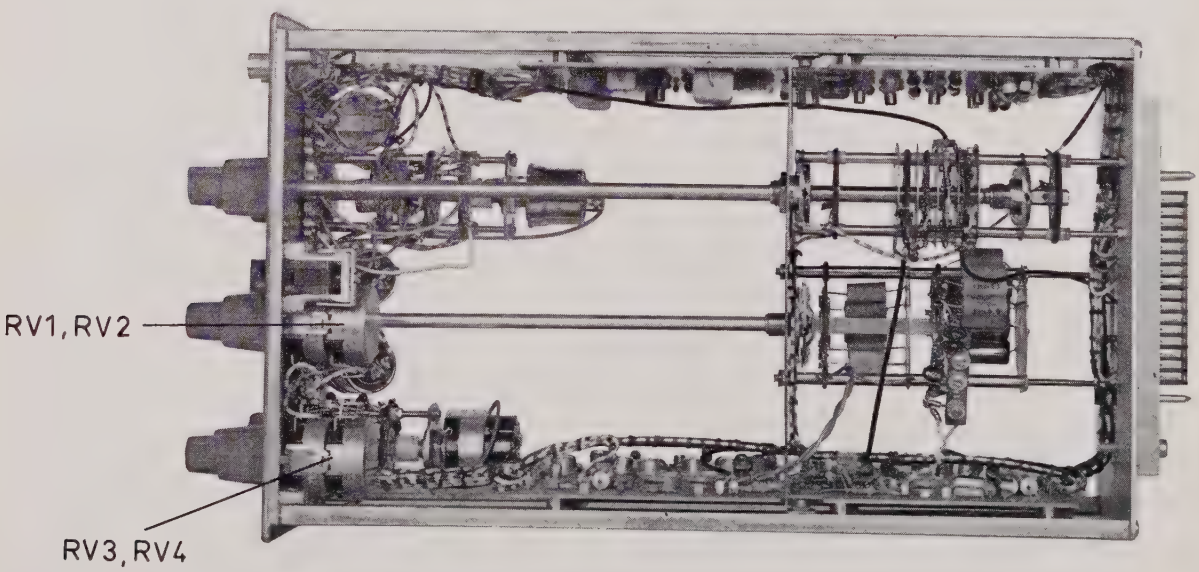


Fig. 5 Bottom view

List of parts

VI

A. MECHANICAL

Item	*Number*	*Code number*	*Description*
1	1	4822 455 80051	Textplate
2	4	4822 159 00318	Knob (S1, 3, 4, 5)
3	2	4822 159 00363	Knob (RV1, 3)
4	4	4822 159 00359	Knob (RV2, 4, 6, 7)
5	1	4822 159 00321	Knob (S2)
6	5	4822 159 00358	Knob cap (S2, RV2, 4, 6, 7)
7	1	4822 159 00364	Knob cap (S3)
8	2	4822 273 80093	Switch (S1, 2)
9	1	4822 273 40175	Switch (S3)
10	1	4822 273 40176	Switch (S4)
11	1	4822 273 80094	Switch (S5)
12	1	4822 276 10219	Switch (S6)
13	4	4822 044 00469	Connector (P1, 2, 3, 4)
14	1	W4 125 73	Plug A (Amphenol: 26-159-32)

B. ELECTRICAL

No standard parts are included in this parts list.
The standard parts in the circuit diagrams (Figs. 8 and 10) are indicated with symbols from which the service code number can be derived.
The key to the code is given below:

	Carbon resistor	0.25 W	≤ 1 MΩ: 5% > 1 MΩ: 10%	902/K...
	Carbon resistor	0.5 W	≤ 10 MΩ: 1% > 10 MΩ: 2%	901/...
	Carbon resistor	0.5 W	≤ 1.5 MΩ: 5% > 1.5 MΩ: 10%	902/P...
	Carbon resistor	0.125 W	5%	902/A...
	Ceramic capacitor	500–700 V		904/...
	Ceramic "Pin-up" capacitor	500 V		904/P...
	Styroflex capacitor	500 V	1%	905/D...
	Polyester capacitor	400 V	10%	906/...

Example:

Code number 901/120K

Code number 904/4E7

RESISTORS

No.	*Code number*	*Value*	*%*	*Watt*	*Description*
R7	4822 071 00587	4.7 Ω	5	0.125	
R14	B8 305 29D/30E	30 Ω	1	0.05	
R15	4822 116 50173	50 Ω	1	0.05	
R16	4822 071 00783	100 Ω	1	0.05	
R17	4822 071 00738	300 Ω	1	0.05	
R18	4822 071 00764	500 Ω	1	0.05	
R19	B8 305 29D/250E	250 Ω	1	0.05	

POTENTIOMETERS

No.	*Code number*	*Value*	*%*	*Watt*	*Description*
RV1, 2	4822 102 10077	10 kΩ 5 kΩ	20 20	0.25 0.25	Duopotentiometer
RV3, 4	4822 102 10078	1 kΩ 100 Ω	20 20	0.25 0.25	Duopotentiometer
RV5	4822 071 01012	330 Ω	5	2	
RV6	E 199 AA/B13B3K5	3.5 kΩ	10	1	
RV7	4822 071 00892	10 kΩ	5	2	
RV8	916/GE20K	20 kΩ	20	0.125	
RV9	4822 071 00716	1 kΩ	5	2	
RV101	4822 140 00393	2 kΩ	20	0.25	
RV102	4822 100 10037	1 kΩ	10	0.25	
RV103	4822 100 10038	500 Ω	10	0.25	
RV104	4822 100 10038	500 Ω	10	0.25	
RV105	4822 140 00381	250 Ω	20	0.25	
RV201	4822 100 10035	10 kΩ	20	0.25	
RV202	4822 100 10037	1 kΩ	10	0.25	

CAPACITORS

No.	*Code number*	*Value*	*%*	*Volt*	*Description*
C2	4822 069 01065	39 nF	10	250	
C4	4822 069 00913	6.8 nF	10	63	
C7	4822 121 40101	100 nF	1	250	
C8	4822 121 40101	100 nF	1	250	
C9	4822 121 50232	20 nF	1	63	
C10	4822 121 50232	20 nF	1	63	
C11	4822 121 50204 4822 121 50211	10 nF	1	63	In parallel
C12	4822 069 00574	2 nF	1	125	
C13	4822 069 00574	2 nF	1	125	
C14	4822 121 50185	910 pF	1	500	
C16	C785 AB/D200E 4822 069 00608	380 pF	1	100	In parallel
C20	909/C1, 6	1.6 µF	—10 +100	25	Electrolytic
C23	4822 069 01105	100 nF	20	250	
C101	4822 069 01105	100 nF	20	250	
C102	4822 069 01105	100 nF	20	250	
C103	4822 069 00677	10 pF	5	30	
C104	4822 069 01093	10 nF	—20 +100	30	
C105	4822 069 01105	100 nF	20	250	
C106	4822 121 50184	820 pF	1	500	
C109	4822 069 01093	10 nF	20	250	
C111	4822 069 01105	100 nF	20	250	
C115	4822 069 01105	100 nF	20	250	
C116	909/Z10	10 µF	—10 +50	25	Electrolytic
C119	4822 069 01105	100 nF	20	250	
C120	4822 069 01105	100 nF	20	250	
C121	4822 069 00957	4 µF	—10 +50	64	Electrolytic
C122	4822 069 01105	100 nF	20	250	
C123	4822 069 00957	4 µF	—10 +50	64	Electrolytic
C124	4822 069 01105	100 nF	20	250	
C125	4822 069 01105	100 nF	20	250	
C126	909/Z10	10 µF	—10 +50	25	Electrolytic
C127	909/Z10	10 µF	—10 +50	25	Electrolytic
C129	4822 069 01105	100 nF	20	250	
C130	4822 069 01105	100 nF	20	250	
C201	4822 069 01105	100 nF	20	250	
C202	909/Z10	10 µF	—10 +50	25	Electrolytic
C203	4822 069 01105	100 nF	20	250	
C204	4822 069 00957	4 µF	—10 +50	64	Electrolytic
C205	4822 069 01105	100 nF	20	250	
C206	4822 069 00957	4 µF	—10 +50	64	Electrolytic
C207	4822 069 01105	100 nF	20	250	
C208	909/Z10	10 µF	—10 +50	25	Electrolytic
C209	4822 069 00622	1 µF	10	250	
C210	4822 069 01064	100 nF	10	250	
C211	4822 069 01105	100 nF	20	250	

No.	*Code number*	*Value*	*%*	*Volt*	*Description*
C212	4822 069 01093	10 nF	20	250	
C213	4822 069 00957	4 µF	—10 +50	64	Electrolytic
C214	4822 069 00622	1 µF	10	250	
C215	4822 069 01105	100 nF	20	250	

VARIABLE CAPACITORS

No.	*Code number*	*Value*	*%*	*Volt*	*Description*
CV1	4822 069 01121	4.5–20 pF		160	
CV2	4822 069 01121	4.5–20 pF		160	
CV3	4822 125 50025	2.5– 6 pF		160	

TRANSFORMERS

No.	*Code number*	*Description*
T1	4822 158 10122	
T2	4822 526 10044	

MISCELLANEOUS

Print 1	4822 216 50111	Printed circuit board with components
Print 2	4822 216 50112	Printed circuit board with components

COILS

No.	*Code number*	*Description*
L1	4822 158 10121	
L2	56 590 65/20	Ferroxcube tube
L101	56 590 65/20	Ferroxcube tube
L102	56 590 65/20	Ferroxcube tube
L103	56 590 65/20	Ferroxcube tube
L104	4822 128 00487	
L105	56 590 65/20	Ferroxcube tube

SEMI CONDUCTORS

No.	*Type*		*Description*
Z1	BA114		Diode
Z2	BZY59		Zener diode
Z101	2N3932	RCA	Transistor
Z102	2N3932	RCA	Transistor
Z103	TD253A	General Electric	Tunnel diode
Z104	BSY39		Transistor
Z105	TD253A	General Electric	Tunnel diode
Z106	ASY27		Transistor
Z107	ASY29		Transistor
Z108	ASY29		Transistor
Z109	AAZ18		Diode
Z110	ASY27		Transistor
Z111	2N2369		Transistor
Z112	BSX29	S.G.S.-Fairchild	Transistor
Z113	MS1705	Micro State Electronics Corp.	Tunnel diode
Z114	ASY29		Transistor
Z115	BSY40		Transistor
Z116	AAZ18		Diode
Z117	BSX29	S.G.S.-Fairchild	Transistor
Z118	BSX27	S.G.S.-Fairchild	Transistor
Z119	BZY56		Zener diode
Z120	MS1705	Micro State Electronics Corp.	Tunnel diode
Z121	2N3932	RCA	Transistor
Z122	BSX29	S.G.S.-Fairchild	Transistor

No.	*Type*		*Description*
Z123	IN4009		Diode
Z124	IN4009		Diode
Z125	BSY38		Transistor
Z126	BC109		Transistor
Z127	BCY34		Transistor
Z128	BCY34		Transistor
Z129	BSX21		Transistor
Z130	ASY29		Transistor
Z131	AAY21		Diode
Z201	IN914		Diode
Z202	IN914		Diode
Z203	BC109		Transistor
Z204	BC109		Transistor
Z205	BA114		Diode
Z206	BA114		Diode
Z207	BC109		Transistor
Z208	BSY38		Transistor
Z209	IN4009		Diode
Z210	IN3716	General Electric	Tunnel diode
Z211	ASY29		Transistor
Z212	BCY30		Transistor
Z213	BC109		Transistor
Z214	BA114		Diode
Z215	BC109		Transistor
Z216	BSY39		Transistor
Z217	BSY39		Transistor
Z218	BC109		Transistor

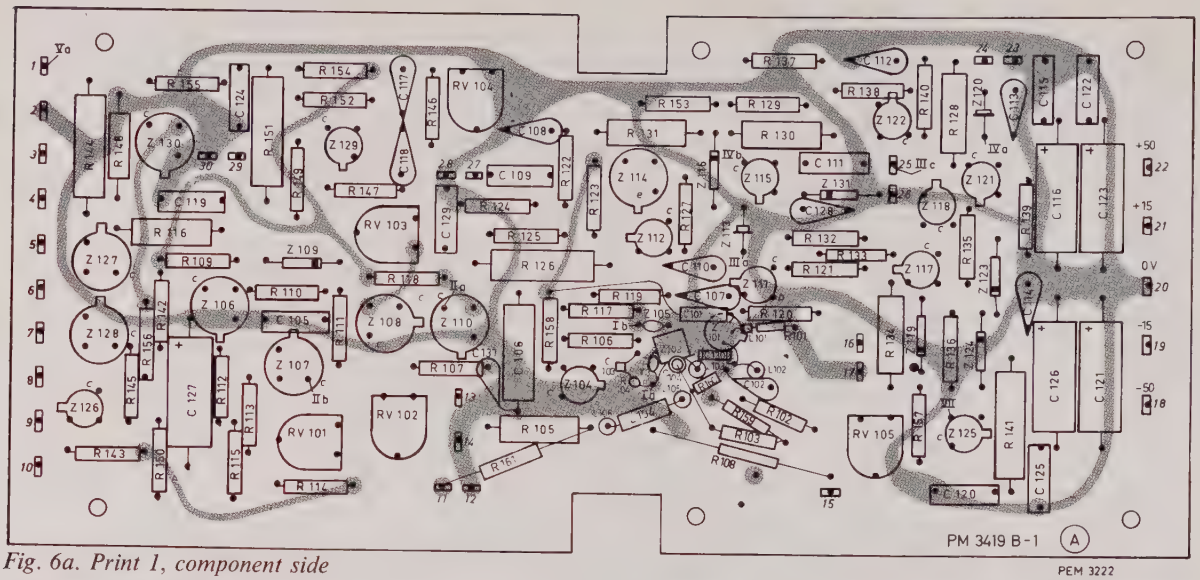


Fig. 6a. Print 1, component side

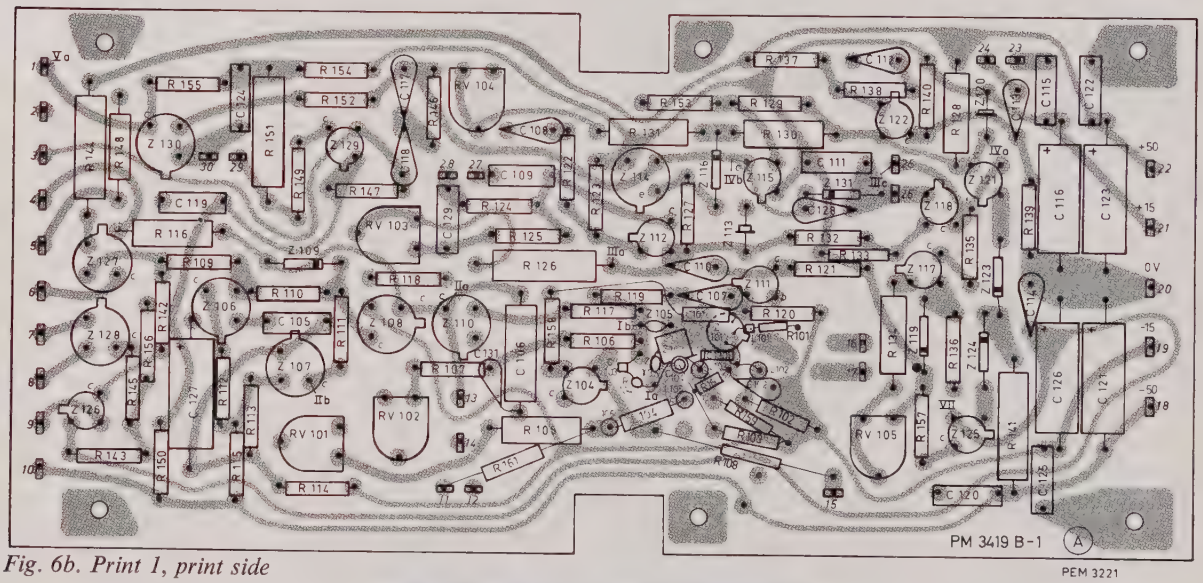
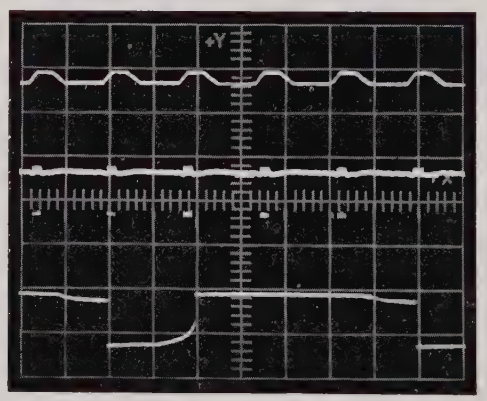


Fig. 6b. Print 1, print side



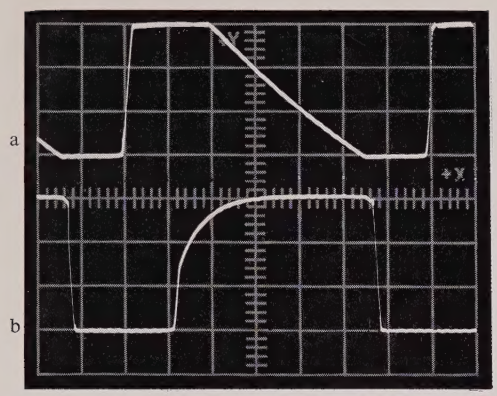
I.

a. External input signal on P3

b. Z103–L105

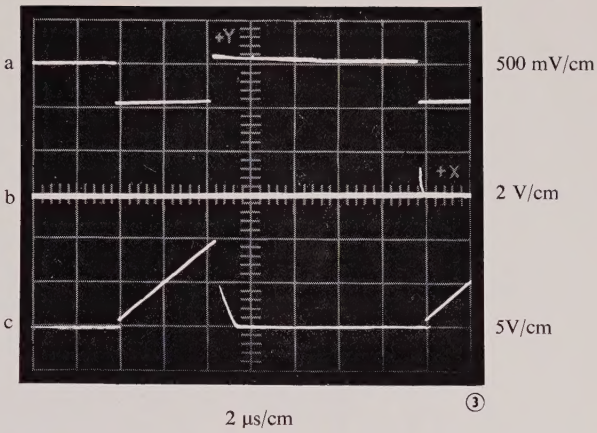
c. Z105

An external trigger signal of waveform "a" is applied to TRIGG. IN, P3.
S1 in position EXT. +.



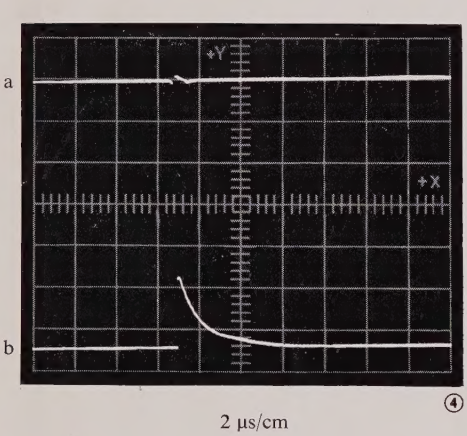
II.
a. Z110 c
b. Z107c

See I.



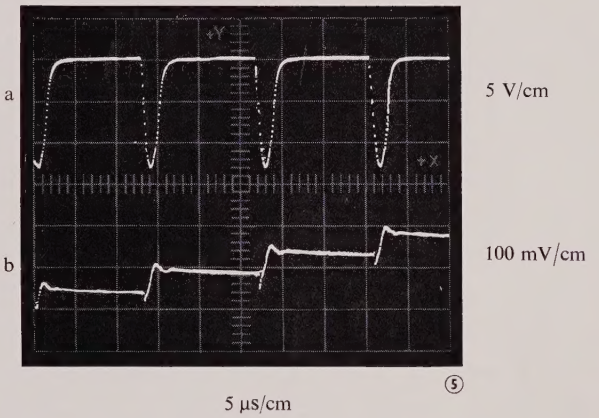
III.
a. Z113
b. TRIGG. OUT P4
c. Z121 b

See I.



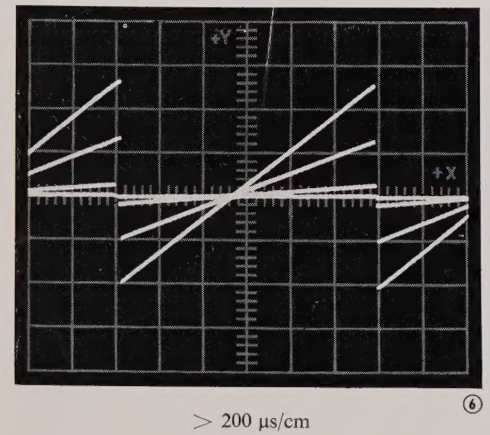
IV.
a. Z120
b. Z115 c

See I.



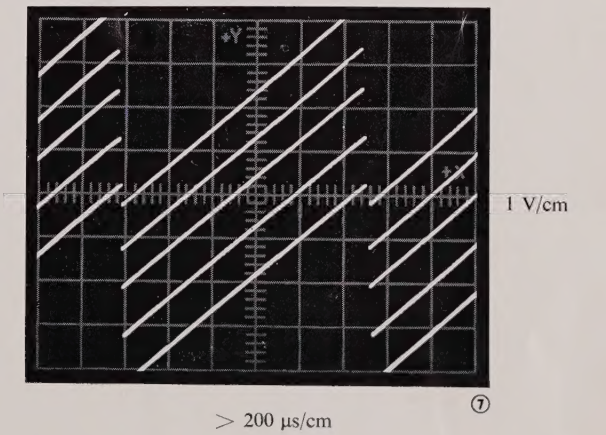
V.
a. Z130 c
b. X OUT P2

See I.
X DEFL. selector in position samples/cm



VI.
RV 5, point 3

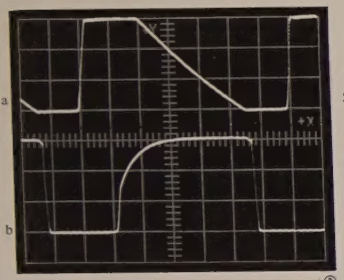
See I.
TIME SCALE MAGN. in positions 1, 2, 10 and 100



VII.
Z125b

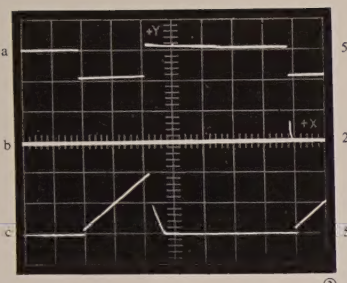
See I.
Five positions of RV 3.

Fig. 7. Oscillograms



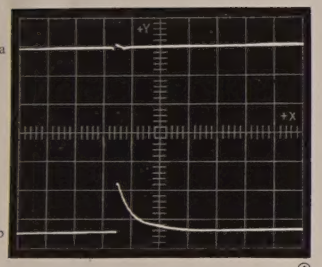
II.
a. Z110 c
b. Z107c

See I.



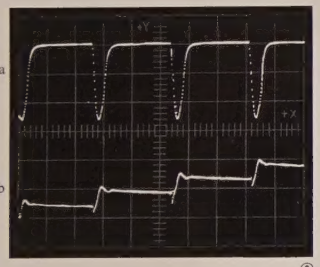
III.
a. Z113
b. TRIGG. OUT P4
c. Z121 b

See I.



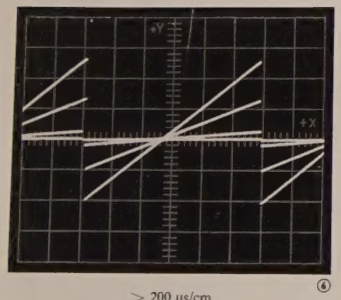
IV.
a. Z120
b. Z115 c

See I.



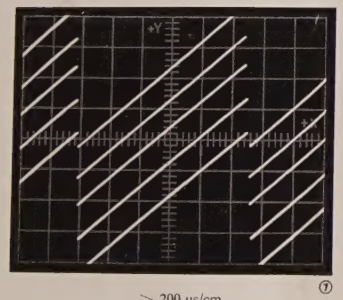
V.
a. Z130 c
b. X OUT P2

See I.
X DEFL. selector in position samples/cm



VI.
RV 5, point 3

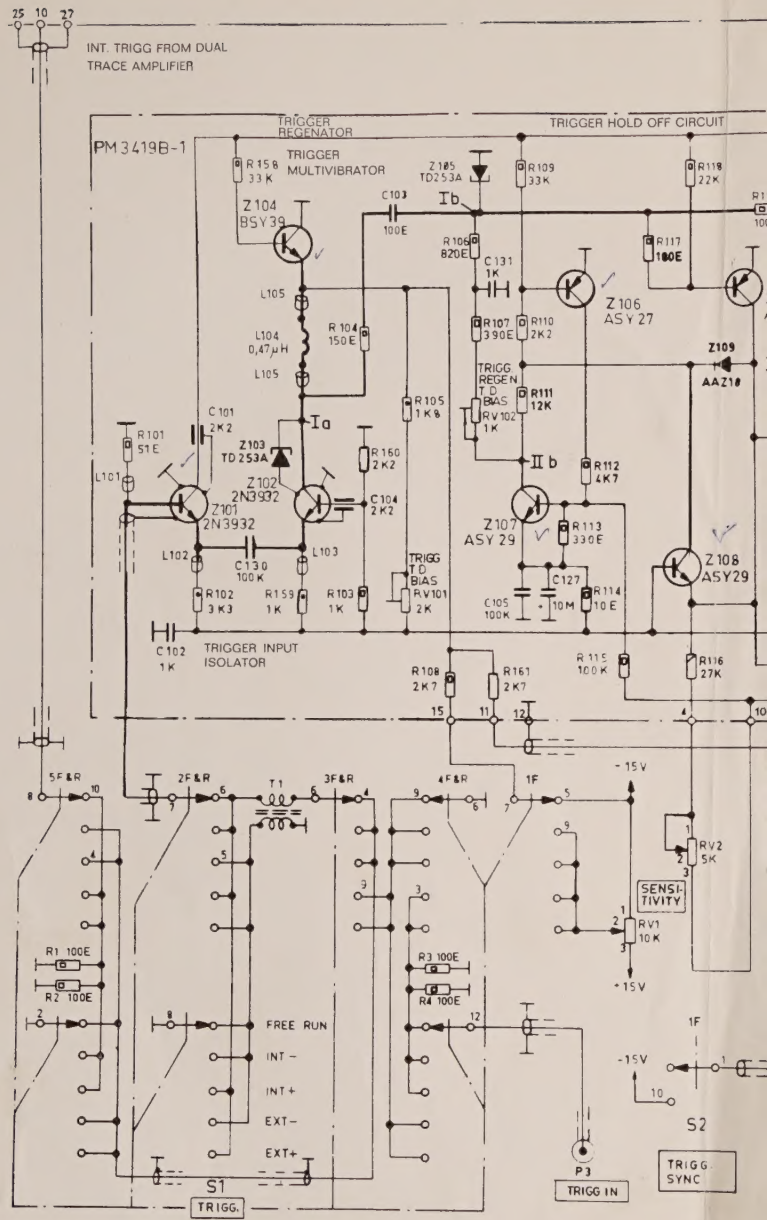
See I.
TIME SCALE MAGN. in positions 1, 2, 10 and 100



VII.
Z125b

See I.
Five positions of RV 3.

Fig. 7. Oscillograms



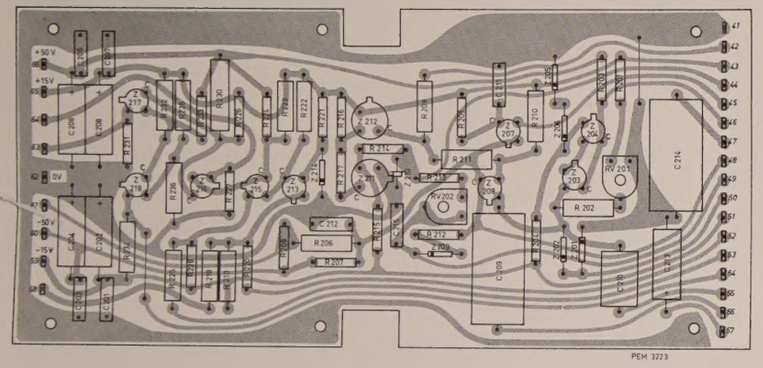


Fig. 9. Print 2

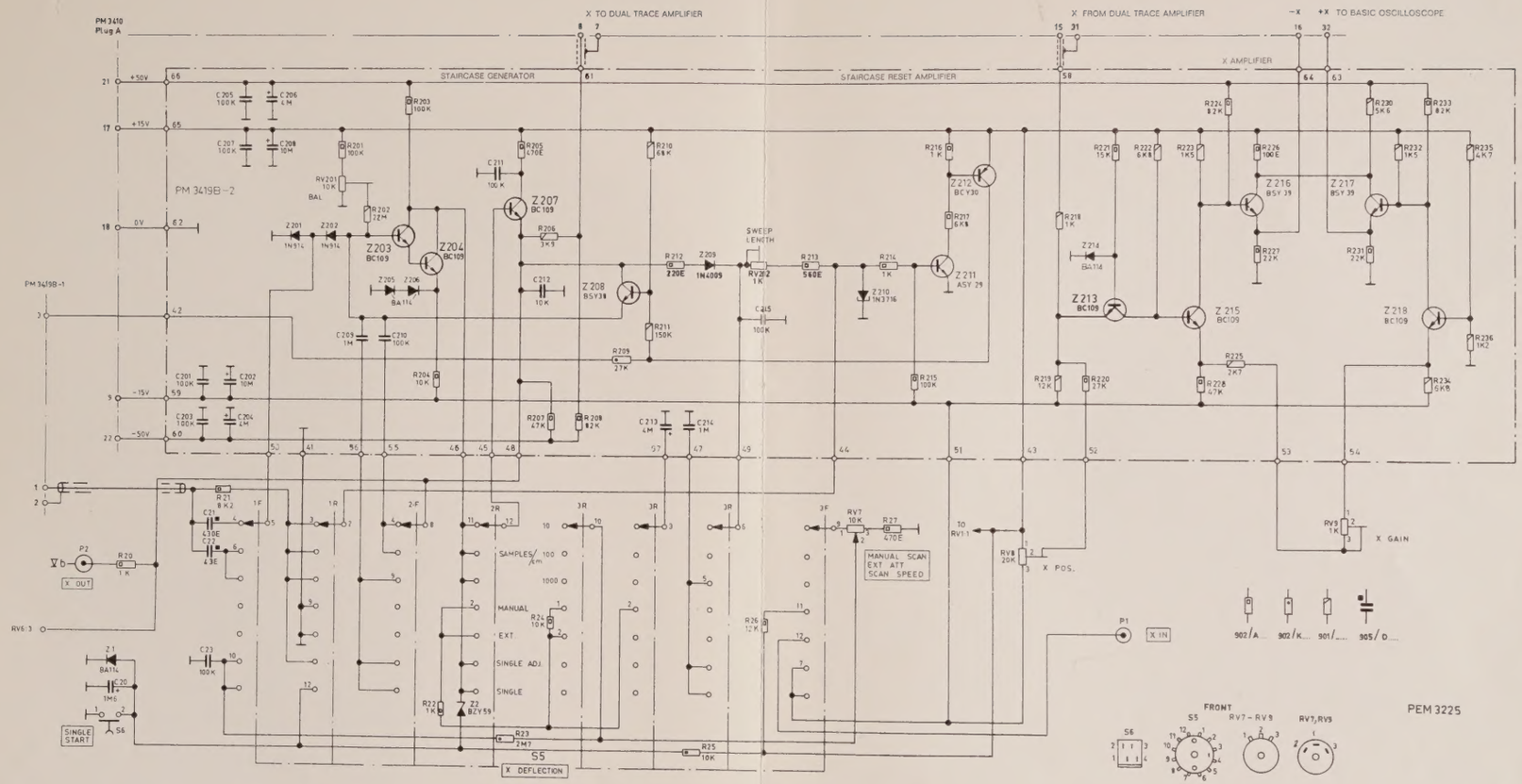


Fig. 10. Circuit diagram

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